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PUNJAB.
INDIAN IRRIGATION COMMISSION.
—
MINUTES OF EVIDENCE.

THE IRRIGATION COMMISSION OF 1901-1902.

PUNJAB.

COLONEL SIR COLIN SCOTT-MONCRIEFF, K.C.M.G., C.S.I. (*President*).

Hon'ble Mr. DENZIL C. J. IBBETSON, C.S.I., I.C.S. | Hon'ble Mr. P. RAJARATNA MUDALIYAR, C.I.E.

Mr. T. HIGHAM, C.I.E.

Hon'ble Mr. J. WILSON, I.C.S. (*Temporary
Member for Punjab*).

Mr. W. B. GORDON (*Secretary*).

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INDIAN IRRIGATION COMMISSION, 1901-02.

MINUTES OF EVIDENCE.

FIRST DAY.

Lahore, 28th October 1901.

WITNESS No. 1—MR. P. J. FAGAN, I.C.S., Revenue Secretary, Punjab Government.

Memorandum I. by witness, relating to irrigation in the Montgomery District.

CULTURABLE AND IRRIGATED AREAS.

1. The needful figures have been given on page 29 of the notes prepared by the Irrigation Department. For some leading statistics I refer to Table I of the Gazetteer (new edition). The latter figures are rather out of date now, and no account is taken in them of the removal of a portion of the trans-Ravi part of the district to Lyallpur. The greater portion of this was Bar waste, now under irrigation or shortly to become so from the Chenab Canal. The figures referred to will, however, serve to show how large a portion of the central part of the district is still waste, much of which is capable of cultivation under canal irrigation. A description of the physical features of the district will be found in paragraph 2 of the Final Settlement Report.

2. So far as Government (Imperial) Canals are concerned and excluding the new irrigation from the Chenab Canal, canal irrigation is confined to the lower lying portion of the district bordering on the Sutlej and south of the old bed of the Beas. The same is the case with the only private canal in the district (Mehdi Khan's) which irrigates on the south-west part of the Pakpattan Tahsil.

The District Board Canals afford irrigation on either side of the Ravi riverain and in the vicinity of the Deg stream. These canals will be dealt with in greater detail below.

3. For some descriptive details of the methods of canal and well-irrigated cultivation in the Montgomery District, reference may be made to pages 117—122 of the Gazetteer and paragraphs 23—26 of the Final Settlement Report. As regards this district, it is a point to be borne carefully in mind as a matter of capital importance that wells are a necessary adjunct to irrigation from inundation canals, while for well cultivation to be really profitable the assistance of a canal is most needful. Irrigation from wells and canals is very largely intermixed.

IMPERIAL CANALS.

4. The imperial Canals of the Montgomery District are—

- (i) The Khanwah.
- (ii) The Upper Sobag.
- (iii) The Kutor.
- (iv) The Lower Sohag and Para.

(i), (ii), and (iii) form the Upper Sutlej Inundation Series, and irrigate both in the Lahore and Montgomery Districts. Some account of them, historical and otherwise, will be found on pages 11—15 and 207 and 208 of the Gazetteer and in

paragraph 3 of the Final Settlement Report. See also Nos. VII and IX of the Irrigation Department Notes.

5. *Area figures.*—The figures for irrigated area from the canals (taken from the Patwaris' returns) will be found in column J, page 73, of Irrigation Department Notes.

The quinquennial average up to 1899-1900 is 142,000 (round) acres. (It does not agree with the average of 186,618 acres shown on page 29 for the reasons given on page 167 in Director of Land Records' Note.) The corresponding figures for the single years 1883-84 and 1888-89 were 85,000 and 111,000 acres (round) respectively. There has thus been considerable development, due largely to the opening of the Lower Sohag and Para in 1887-88. As the supply in an inundation canal is necessarily uncertain, there is not an invariable increase of irrigation in a famine year. All depends on the volume of the river and the direction of its flow with reference to the position of the head-works. Looking to the fact that complete irrigation for the purposes of ripening crops from these canals is confined to the kharif, the duty shown in Irrigation Department Statement XVI-E compares not unfavourably with other canals. See, however, (b) in the next paragraph.

6. *Future development.*—While I was in the district, a new rajbaha from the right bank of the Para Branch of the Lower Sohag and Para was in contemplation. It would supply irrigation to an extensive tract north and north-west of Pakpattan. It is, I understand, now under construction or just about to be so, as sanction of the Government of India has just been received for the project as well as for another distributary. So far as my experience goes, much could be done for the greater security and development of irrigation from these canals by—

- (a) improvement of the head-works, if possible, by the provision of weirs, etc., with a view to ensuring a less varying and more abundant supply in these canals;
- (b) by the straightening and curtailment of the number of village water-courses.

With reference to (a), one of the main drawbacks to these canals is the danger of the supply failing at a critical time in the kharif irrigating season. As regards (b), in many cases two adjacent villages will have separate water-courses running parallel for long distances from adjacent heads on the canal bank. This possibly prevents dispute as to irrigation, but obviously involves extensive waste of water by evaporation and percolation, which would be avoided by having a

Mr. Fagan.
28 Oct. 01.

single joint water-course. A considerable increase in duty would, I think, be secured by this improvement. I am not aware how far, if at all, these suggested improvements have been definitely held in view owing to want of funds. So far as I am aware, no definite projects have been framed with reference to them, but see paragraph 5 of No. IX of Irrigation Department Notes.

7. *Financial details.*—The professional details required under this head will, no doubt, be furnished by the officers of the Irrigation Department. I invite attention to the excellent Statement No. XVI-E in the Irrigation Department Notes. The capital account of these canals, more especially

that of the Upper Sutlej Inundation Series, is low as compared with most other Government canals; this is shown by the low incidence of capital cost per acre of supply and per acre of average irrigated area (stages 47–50). In the case of the Upper Sutlej Series this is, no doubt, largely due to the fact that the canals were in existence before British rule, though they have been very extensively renovated since. The same applies in a minor degree to the Lower Sohag and Para Canal.

Taking the figures given in stages 49–58 of Statement XVI-E, we obtain the following result:—

	AVERAGE OF LAST 10 YEARS.			AVERAGE OF LAST YEAR.		
	Net profit.	Capital cost.	Rate of profit.	Net profit.	Capital cost.	Rate of profit.
	Rs.	Rs.	Per cent.	Rs.	Rs.	Per cent.
Lower Sohag and Para	53	102	53	10	103	100
Upper Sutlej Canals	54	40	117	65	44	147

They show, I think, that the canals under reference are financially productive, and they compare favourably with the results on most of the major perennial canals. The improved rate of profits during the last three years is due largely to the imposition of a fluctuating canal-advantage land revenue rate, the proceeds of which are treated as indirect canal income. Prior to the recent re-assessment, the canals were not receiving credit for all the income produced by them. The figures given in paragraph 4 of Irrigation Department Note VII and paragraph 5 of No. IX apparently include direct income only. At the quinquennial revision of water (occupier's) rates, it will, I anticipate, be found possible to raise those at present in force, and this should still further increase the rate of net profit. In connection with the above, reference may be made to paragraphs 106 and 107 of the Final Report of the recent settlement. I can only reiterate the remarks there made as to the liberal treatment of these canals in the matter of funds.

8. *Rabi supply.*—The discharge and supply figures given in stages 3–11, Statement XVI-E, in Irrigation Department Notes, columns VII and IX, indicate that the rabi supply cannot be separately calculated. This is, of course, due to the canals being inundation canals, which give under ordinary circumstances full irrigation for the kharif harvest alone, while for the rabi they can provide only a watering or two preliminary to ploughing and sowing. The only method of increasing the rabi supply is by constructing a weir or undertaking improvements of the head-works short of this.

9. *New projects.*—As regards the Sutlej Riverain—

(a) There is, I believe, a considerable field for the development of irrigation in the south-west part of Pakpattan (see end of Irrigation Department Note at page 29, and also No. XXXVIII at page 141). A properly designed canal would irrigate not only many of the more remote riverain villages which have of late years been largely deprived of river floods, but also a considerable waste tract which used in former days to be watered by the Beas and by branches or creeks of the Sutlej. The tract under reference is much intersected by old nullahs (see pages 17–19 of the Gazetteer), and this would perhaps cause some additional difficulty and expense in the construction of a canal, but it is, I consider, by no means an absolute bar to the project.

(b) The Lower Bari Doab Canal Project, which intimately concerns the Montgomery District, is dealt with in No. XVI of the Irrigation Department Notes. The Bet tracts referred to therein are, I understand, those on either side of the high central ridge of the district (see map attached to Final Settlement Report) and the dry channels of the Beas on the south and the Sukhrwa on the north.

Most of the area to be commanded by the projected canal would under irrigation be fairly fertile and productive, but a good deal of it, especially in the central ridge, is largely impregnated with alkali salts, which, for a time at least, would hamper cultivation.

PROVINCIAL CANALS.

10. There are no Provincial Canals in the district, except the Hojiwah, the head of which is on the Mooltan border and irrigates in that district.

DISTRICT BOARD CANALS.

11. The District Board Canals are mentioned on page 29 of Irrigation Department Notes and also in Note XLIII on page 161 of the Collection. Some description of them will be found at pages 7–10 of the District Gazetteer.

Some of them were in my time little more than river-beds or water-courses of a respectable kind. I had not much direct connection with the canals while I was in the district, and Mr. Kitchin is more competent to speak about them than I am; but my impression is that they did not receive at all adequate credits in respect of income really created by them, much of the latter being fluctuating land revenue. It is, I understand, under contemplation to provincialize these canals. I am inclined to think that the step would be a sound one. The supply in the Ravi is precarious, and in all probability expensive excavation of new heads will be required from time to time, and this would, I should imagine, be somewhat beyond the means of the District Board in its present impoverished condition. If the Ravi District Board Canals are provincialized, there will be little scope for District Board enterprise in connection with canals in that part of the district; while the Sutlej side is already fairly completely occupied by the Irrigation Department, and will be entirely so if the Pakpattan Canal project is developed.

PRIVATE CANALS.

12. There is only one important private canal in the district, namely Mahdi Khan's. Some description of it will be found in the appended extract paragraphs 2, 5, and 9 from a report prepared by me as Settlement Collector (No. 1457, dated 21st November 1899). In former times private enterprise was largely directed towards the excavation of channels or water-courses from the rivers (see page 15 of the Gazetteer). They are very numerous on the north of the Ravi in the neighbourhood of Kamalia. They cannot claim to be considered canals. In view of the projects dealt with above, I do not think that there is likely to be much, if any, field for private enterprise in canal construction in the future.

WELL IRRIGATION.

13. Well irrigation in the Montgomery District is to a very large extent an adjunct to canal irrigation, or rather the two are mutually inter-dependent. A well, especially in the Bar tracts, which is unaided by canal water or river spill, has not much attraction for the local cultivator. Apart from an extension of canal irrigation, there is, I consider, little prospect of any marked increase in the number of wells. Such increase as has occurred in the past has been mainly in connection with canal extensions in the Sutlej Tahsils. The depth to water in the wells, of course, varies largely. In the Trans-Ravi (Rebana) Bar tract it averages about 40 feet, but in some cases rises to 70 feet or more. In the Bari Doab Bar it varies from an average of 35 to one of 60 feet in different portions of the tract. In the lower lying tract near the rivers the limits are 20 and 30 feet, or an average of 25 feet. The abandonment of wells is generally due to (1) migration of tenants, (2) serious damage to the well cylinder or collapse of the well. Cause (1) is the most frequent one. The average unnaal area irrigated per well varies from 10 to 20 acres in the Ravi Tahsils and from 20 to 30 on the Sutlej. In all tracts, but more especially of course those not touched by canals, the efficiency of well cultivation depends largely on the rainfall. The cost of erecting a masonry well varies from Rs. 250 to Rs. 550. Further particulars about well cultivation and construction will be found at pages 117–122 of the Gazetteer. I must apologize for several defects in this note. It has been prepared at very short notice and under great pressure of work.

Appendix to Mr. Fagan's memorandum on the Montgomery District.

Extract paragraphs 2, 5, and 9 of letter No. 1457, dated 21st November 1898, from P. J. FAGAN, Esq., Settlement Officer, Montgomery, to the Settlement Commissioner, Punjab.

2. *The grant of Chak Mehdi Khan or Faizabad.*—Under instructions from the Financial Commissioner conveyed in Senior Secretary's No. 5944 of 25th August 1880, to Commissioner, Mooltan, the Deputy Commissioner of Montgomery in his No. 297 of 24th September 1880, to the Commissioner of Mooltan, submitted proposals for a grant on lease of 4,000 acres of Government waste land in the Montgomery Tahsil to Faiz-ul-Hassan, retired Extra Assistant Commissioner and then Chief Judge in the Bahawalpur State. The Financial Commissioner made detailed recommendations regarding the grant in his Secretary's No. 436 of 2nd May 1881 to the Secretary to Punjab Government. The grant in the form of a lease was sanctioned on the conditions proposed in Punjab Government No. 557 of 16th May 1881, to the Secretary to Financial Commissioner. The conditions as to assessment were that for the first five years the grant was to be rent-free; for the second five years an annual rent of Rs. 250; and for the third five years one of Rs. 500 was to be charged. For the last five years the lessee was to pay whatever assessment should be imposed at next settlement plus a malikana calculated at 15 per cent. on that assessment. In case of no new assessment having been made, a rent of Rs. 750 was to be charged. The lessee was to be permitted to excavate and complete a private canal from the Sutlej within five years from the date of the execution of a lease; Government retaining power to appropriate without compensation and to take under its management such canal on the expiration of the lease. Shortly after the grant had been sanctioned, and before any lease was executed, Faiz-ul-Hassan died, and his son and heir Muhammad Hassan agreed to admit Muhammad Mohdi Khan to a share in the grant which had been sanctioned for Faiz-ul-Hassan. This arrangement was sanctioned in letter No. 3110 of 26th April 1882, from Senior Secretary to Financial Commissioner, to Commissioner, Mooltan, it being understood that the names of Mehdi Khan and Muhammad Hassan would both be entered in the deed of lease as jointly and severally responsible for all the terms and stipulations thereof. A formal lease was accordingly prepared and executed on the 17th of July 1882. The lease is for 4,000 acres, and contains no detail of the shares of the co-lessees. It gives a right of pre-emption, and

expires in kharif 1903. The grant is now known as Chak Mr. Fagan: Mohdi Khan or Faizabad.

5. *The private inundation canal.*—The private inundation canal referred to in the lease was constructed within three years from the date of the lease. The length of the main canal is about 19 miles; near the boundary of Chak Mehdi Khan it divides into two branches, 4½ and 6 miles long respectively. The canal irrigates both grants. Its head is on the Sutlej at the village Rahmani Malkana, and before reaching the two grants, it passes through a considerable number of Bet villages, but the irrigation which they receive from it is mostly by jhallars. Irrigation is also received by several of the estates of the Bar Circle which are in the vicinity of the grants; this is also to a considerable extent carried on by lift. The bulk of the flow irrigation is in the two grants themselves. The map attached to this report shows the position of the canal. The lessees, who are also in possession of the canal, charge water-rates for irrigation from it to estates other than the grants. These rates are per acre of mature crop:—

	Rs.	A.	P.
Rice	2	8	0
Til and cotton	2	0	0
Other kharif crops	1	8	0
Rabi crops	1	8	0

Lift irrigation is charged at half rates.

9. *Future management of the canal.*—Government is entitled to take over the canal without payment of compensation on the expiry of the lease of Chak Mehdi Khan. A professional survey and inspection of the canal by the officers of the Canal Department will, no doubt, be necessary before it can be fully decided whether it will be advisable to do so. Apart from possible professional objections, I consider that its appropriation and management by Government will be distinctly beneficial, and that an extensive development of canal irrigation in the Bar tract will be found to be quite possible. Ghulam Jilani Khan, the eldest son of the late Muhammad Mehdi Khan, has stated explicitly before me that he has entered into no arrangements with other persons securing their irrigation from the canal for any period in excess of one year.

I am strongly of opinion that, if and when the canal is taken over by Government, some recognition of the fact that the canal was constructed by the lessees should be made, though they, of course, have no legal title whatever to compensation. This might take the form of remission of one-half or higher proportion of the water (occupier's) rates, which will, no doubt, be imposed on all land held by the heirs of Mohdi Khan for a term of five or ten years.

Memorandum II on the Shah Nahr Canal, Hoshiarpur District.

Some account of the history of the Shah Nahr Canal will be found at page 16 of the Irrigation Department Notes, and at greater length in Punjab Government Proceedings [Revenue and Agriculture (Irrigation)] for August 1890, Nos. 8—14, for November 1890, Nos. 1 and 2, and for March 1891, Nos. 9—11. The canal has been managed up to date under the arrangements described in the above papers. Proposals for modification in certain directions are under consideration, and will be noticed below. The present Manager is Gureharan Singh, son of Kharak Singh. He is, I understand, to be called as a witness before the Commission.

2. The canal is in reality of the inundation type, but even after the river has subsided, a fair supply of water is available through the cold weather and practically up to the next flood season. Irrigation is thus possible all the year round, but very little water is taken for the rabi (see below). The head of the canal is near the village of Sariaana on an old bed, or creek of the Beas, which connects with that river a considerable distance above the head near the village of Changarwan. This old creek is for practical purposes a part of the canal, and a considerable portion of the annual cost of maintenance is incurred in connection with its clearance. The work is difficult and expensive, as the bed of the creek consists largely of boulders.

3. The canal traverses the northern part of the Munkerni Tahsil. Irrigation is confined almost entirely to the kharif: a good deal of sugar-cane is grown. Very little water is taken for rabi sowings. Rice is a chief crop in the kharif, and unirrigated wheat is extensively sown in the rabi on

the rice fields; its germination and early growth is, of course, largely helped by the moisture left by the rice crop. Very little gram is grown on the rice.

4. There are village distributaries or water-courses (nals) from the main canal, the bed width of which near its head is 50 feet and depth 12 to 15 feet. At the tail near the village of Unchi Bassi the width is some 6 feet. Katoba outlets are used in the water-courses, and dams are allowed in front of these. On the main canal the outlets are generally pakka, and no dams are allowed.

5. I give below figures for the last six years for areas in acres, collections other than owner's rates, and expenditure:—

	Area irrigated.	Area assessed.	Receipts.	Expenditure.
			Rs.	Rs.
1890-91	7,146	6,963	4,426	1,411
1894-95	Not available.		4,825	5,086
1895-96			5,061	5,219
1896-97	10,803	10,161	7,273	5,263
1897-98	10,608	10,442	4,821	5,107
1898-99	11,388	11,076	10,096	5,232
1899-1900	11,651	9,709	6,420	5,203

The figures for 1890-91 (paragraph 6 below) are added for comparison. The difference between columns 2 and 3 represents failed area.

28 Oct. 01.

Mr. Fagan. Receipts and charges are accounted for in the Provincial accounts under—

28 Oct. 01.

Major head—XXX and 43—Irrigation, Minor Works and Navigation.

Sub-head—In charge of Civil Officers.

Detailed head—Shahi-Nahr Canal.

The total receipts under the head XXX—Irrigation for the nine years ending 1898-99 from 1890-91, when the canal was taken over by Government, have been Rs. 51,665, giving an annual average of Rs. 5,741; the corresponding figures for expenditure are Rs. 41,707 and Rs. 4,666.

6. The canal was taken over by Government for management and maintenance in 1890 under a formal deed of agreement with the owners, which will be found among the papers quoted in paragraph 1 of this memorandum. Though not expressly provided in the agreement, it has been laid down by the Punjab Government that the income realized by Government under head XXX should cover expenses of management and provide a surplus for extensions and improvements. Proposals are under consideration for securing that this intention shall be more fully carried out in future than it has been in the past.

7. The correspondence regarding the proposed extension of the canal referred to at page 95 of Irrigation Department Notes will be found in Punjab Government Proceedings [Revenue and Agriculture (Irrigation)] for September 1899, Nos. 15—25, and ditto for August 1900, Nos. 11—22. It has been found that the excess of provincial income over expenditure since the canal was taken over has been considerably greater than was at first thought to be the case, and a further reference in the subject of the construction of the Singhowal

Distributary is now under the consideration of Government. It has been recommended that rice cultivation on the extension should be prohibited; and that no contributions should be accepted from the would-be irrigators from the proposed extension.

The present Dhamianwala Distributary (of which the Singhowal will be an extension) is an old nala dug some 30 years ago by the people of the village of Dhamian. They are not co-sharers on the canal. Its head is at Bhamnal on an upper reach of the canal. The extension is much desired, and will be of much benefit, more especially if rice cultivation is prohibited.

8. Other extensions of the canal are, I think, possible in the shape of two distributaries from the right bank: one with its head near Budhabar and running towards Bhangala and the other with its head lower down the canal near Mukerian. These projects have not yet been worked out; they would perhaps irrigate annually 800 and 500 acres respectively.

9. Farther measures for the improvement of irrigation from the canal would include a system for compelling the clearance of village water-courses (nalas) and the establishment of warabadi arrangements. The latter is, of course, not easy on an inundation canal, and paragraph 12 of the agreement, under which the canal was taken over, also increases the difficulty. The Minor Canals Bill, when it becomes law, will probably facilitate the decision of these questions and other cognate ones.

10. The water rate which can be levied from irrigating co-sharers is limited to Re. 1-6-0 per ghuma (= 759 acres). The rate at present is Re. 1-2-0 taken from co-sharers and non-co-sharers alike. A considerably higher rate than Re. 1-6-0 would, I think, be taken from non-co-sharers, and an enhancement in their case can be made at any time.

Memorandum III (Financial) on Imperial and Provincial Canals.

1. The two main classes into which Irrigation Works are divided for financial and account purposes are:—

(1) Productive Works, dealt with under Budget Heads XXIX and 42, 49.

These are also called Major Works. 49 is a major head of capital outlay under expenditure not charged to Revenue.

(2) Minor Works, dealt with under Budget Heads XXX and 43; the latter is a head and expenditure charged to Revenue.

There is, however, a Class (3) Protective Irrigation Works, the cost of the construction of which is dealt with under Major Head 35, subordinate to Famine Relief and Insurance, such expenditure being chargeable to Revenue. These Protective Works may be classed as Major Works or Minor Works.

2. Works classed as Productive (1) above are, in the first instance at any rate, wholly Imperial. The effect of the rules in Chapter XV of the Public Works Department Code is to forbid the construction of a Productive Work directly from Provincial Funds. See especially articles 2121—2123, 2130. Local Governments, however, may play an important part in the initiation of such works. See articles 2136, 2139—2148, 2151 and 2152, Public Works Department Code, and the financial arrangements during construction are to some extent under their control (articles 2146—2160). Article 2153 contemplates the provincialization of productive Works. The last article and articles 2151 and 2152 reproduce the order contained in Government of India, Finance, Resolution No. 2009, dated 23rd March 1878. But the operation of the latter two articles has been rendered somewhat easier for Local Governments by the recommendations contained in Volume II, Chapter XI, Section E, page 289 of the Report of the Finance Committee of 1885 (vide paragraph 4 of Financial memorandum by Mr. Laville, Assistant Secretary, Financial, to Punjab Government, and the papers quoted by him). The system of provincialization has been adopted in the case of the Jhelum canal and of the Sirsa branch of the Western Jumna canal, but it will not take

effect until the expiration of ten years from the opening of these works, or sooner, at the option of the Local Government. At present all direct receipts from Major Irrigation Works are wholly Imperial under the terms of the current Provincial contract. It is, I think, for consideration whether some of the existing Major Irrigation Works should not be provincialized on the lines laid down in paragraph 8, Chapter XI of the report of the Finance Committee, quoted above.

The Major Works at present in existence are:—

I.—Swat River canal (Protective).

II.—Western Jamna, including Sirsa branch (Productive).

III.—Bari Doab canal (Productive).

IV.—Sirhind (Productive).

V.—Chenab Canal (Productive).

VI.—Jhelum (Productive).

VII.—Lower Sahag and Para (Productive) (Inundation).

VIII.—Sidhnai (Productive) (Not perennial).

3. Minor Irrigation Works are (a) Imperial, (b) Provincial. The financial rules regarding them are contained in Chapter XIX of Public Works Department Code, articles 2201—2211. They can be constructed by Local Governments subject to the above rules and to those contained in Chapters XVI and XVII.

Funds for Minor Irrigation Works are provided from revenue, and not from loans; and in the case of Imperial Works, at any rate, this appears to lead to curtailment of the means required for extension and improvement. See

paragraph 2 of a Memorandum on Irrigation of River Valleys by the Honourable Mr. J. Wilson, Settlement Commissioner.

The following figures for the last two complete years illustrate the point :—

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	Year.	Direct receipts.	DIRECT EXPENDITURE.		
			Capital.	Working expenses.	Total.
			Rs.	Rs.	Rs.
Major Irrigation Works (Imperial)	1890-1900 . .	1,26,31,784	44,97,371	35,78,492	83,75,863
	1900-1901 . .	1,36,37,486	45,16,863	40,10,843	85,57,726
Minor Works (Imperial)	1890-1900 . .	8,94,863	64,099	13,31,006	13,86,005
	1900-1901 . .	8,99,291	49,861	13,25,839	13,66,700
Minor Works (Provincial)	1890-1900 . .	41,428	1,520	28,310	29,836
	1900-1901 . .	1,89,733	14,481	73,686	88,667

The Minor Imperial Irrigation Works of the Province are:—

- I.—Upper Sutlej Inundation Canals.
- II.—Lower Sutlej and Cheenb Inundation Canals.
- III.—Indus Inundation Canals.
- IV.—Shahpur (Imperial) Inundation Canals.
- V.—MuzaFargah Inundation Canals.
- VI.—Ghaggar Canal.

The Provincial works (Minor Works) are detailed in the statements appended to Mr. Laville's note, and will be dealt with below.

4. Of the Minor (Imperial) Irrigation Works Capital and Revenue Accounts are kept [Article 2203 (a), Public Works Department Code] for all except No. V above, for which only Revenue Accounts are kept. There should therefore, as regards proposed extensions and improvements, be no difficulty in forecasting financial results. Article 2203, Public Works Department Code, provides for further capital expenditure on this class of works, which, so far as this Province is concerned, are all inundation canals. The point for decision is whether such works are sufficiently profitable to justify the expenditure of borrowed capital on them. That they have been so in the past, there can, I think, be no doubt. At present they have to compete with the large perennial canals, and this will be increasingly the case in the future as the contemplated large schemes are carried out; still there must, I think, always continue to be a fairly wide field for irrigation in the Punjab riverain tracts, and reasonable expenditure of borrowed capital or more extensive expenditure than at present of funds derived from revenue will, I believe, be found remunerative; and beyond this there is the consideration of our moral obligations to the riverain land-owners whom our perennial canals injure directly, whatever may be the indirect benefits which they derive from them.

5. Mr. Laville has dealt with the subject of Provincial canals in his Memorandum, and he has given most, if not all, the information required by paragraph 3 of the Memorandum issued by the Commission. There is little for me to add. Further information is also available in the Irrigation Department Notes.

(The President). 1.—Q. I understand, Mr. Fagan, you are Financial and Revenue Secretary to the Government of the Punjab?—Yes.

2. Q. What districts have you served in in the Punjab?—In Montgomery.

3. Q. Have you had any experience of famine relief works?—No.

4. Q. You doubtless had a good deal to do with District Boards?—Yes, a fair amount, more especially in the District of Hoshiarpur.

5. Q. Do you think that they could be usefully employed in the control of minor canals?—No. My impression is that District Boards are not qualified to deal with irrigation questions. I think they could only deal with them under professional advice from the Irrigation Department.

6. The limitations which exist in regard to the expenditure on the construction of Irrigation Works by Local Governments have been indicated in the opening sentences of paragraphs 2 and 3. Such works must be Minor Works and paid for from Revenue.

At the time of passing the last Provincial contract in 1896-97 the Government of India, in response to an appeal from the Local Government, allowed the estimate of prospective annual expenditure under Head 43 to be fixed at the prospective total amount of annual receipts under Head XXX, i.e., Rs. 1,18,000, in place of an estimate of Rs. 72,000 based on the actual expenditure of the period of the previous contract; but as noted by Mr. Laville at the end of his note, the Punjab Government has not been able to take advantage of this concession owing to unforeseen expenditure on plague and famine. I agree with Mr. Laville in thinking that the Provincial contract system does not, on the whole, operate to discourage the application of available Provincial surpluses to the construction of Minor Irrigation Works. It is to the interest of the Provincial Government to so utilize such surpluses, otherwise they may have to be surrendered at the end of the period of the contract; or absorbed in the arrangement of the next contract. This last consideration would tend, I think, to discourage the undertaking by the Local Government of large schemes which may take two or three years to complete, inasmuch as the contract period may terminate in that interval and the surplus Provincial Funds intended for expenditure on the work disappear in the manner noted above. I think that it would be well that at the time of passing a new contract the existence of any such large current Provincial Irrigation Projects should be borne in mind by Government of India.

7. On the question whether it is advisable to apply Provincial Funds to the construction of Irrigation Works my reply would be that it certainly is so in the case of Minor Works. For Major Works borrowed capital is needed, so that the present arrangements referred to in paragraph 2 above must be maintained so far as they are concerned. Even in the case of a local debenture loan the Local Government acts merely as the Agent of the Government of India (Article 2126, Public Works Department Code).

They have not the means or personnel needful for running canals on approved professional lines. The Irrigation Department is the proper agency, and the District Board might content itself with nominal control.

8. Q. But are there not a good many useful minor irrigation works which practically want little or no scientific supervision?—In Montgomery there are a good many. I did not, however, have much to do with them in that district, but Mr. Kitchin will be in a position to say more about it. I understand from him that, partly owing to the fact that District Board funds are run down, they really have not the means to carry them on. They were originally constructed by the District Board, and the alignment in many cases is wrong and impairs their efficiency. I don't think District Boards can do much except perhaps merely as pioneers. They cannot manage works on anything like a scientific system.

Mr. Fagan. 7. Q. I suppose their powers of co-operation are not very great?—My experience has been that it is rather difficult to get District Boards to take much interest of their own accord unless they are suitably induced.

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8. Q. I understand generally that in the Punjab rabi is the chief crop?—Yes, in most districts; certainly in Montgomery.

9. Q. What is the rainfall of that district?—The average is about 9 to 10 inches for the last ten years. For the last two years there has been practically nothing at all.

10. Q. Then the kharif crops raised in that district are from the inundation canals?—Yes.

11. Q. They don't trust to rainfall?—No, except in old beds of nullahs which receive drainage from higher levels.

12. Q. What are the chief kharif crops?—Cotton is the main crop, a little maize, a large amount of *churri* for fodder, and a certain amount of *moth* and pulses.

13. Q. Is there much rabi grown in Montgomery District?—A considerable amount, much of it helped by inundation. When they get the first water from the inundation canals in September, the ground is ploughed, and sowing takes place later on.

14. Q. Then the inundation canals generally dry up?—Yes.

15. Q. Do they count on the cold weather rains for ripening the crop?—Yes, and also on wells.

16. Q. Would there be a great extension of kharif if more water were given?—Yes. They probably would extend cotton cultivation. I don't think all the water would be devoted to extension of kharif. It would be devoted to the extension of rabi as well.

17. Q. I suppose cotton is far and the most valuable crop?—Yes; I think so.

18. Q. You say wells are always used to supplement irrigation?—Yes. It depends a good deal on the relative efficiency of the canals. Where the well supply is a low one, I would say the canal helps the well.

19. Q. It must require a large number of wells to maintain irrigation started by the canal. What is the irrigation per well?—I suppose in the Satlej Tehsil it would run to say thirty acres with plenty of canal water to start with and winter rains.

20. Q. Supposing inundation canals ran dry by 1st December?—They would then depend on wells altogether. Provided they had good moisture for sowing and fair winter rains, they can do that.

21. Q. Are they *pukka* wells?—Yes. Practically all of them. There are a certain number of *Jhadars* on the river bank for lift irrigation and also on water-courses.

22. Q. Are the agricultural classes generally in a position to go on making wells? Do they want help from Government?—They take a certain amount of *takari* from Government in Montgomery.

23. Q. Do you consider any change necessary in the matter of giving assistance?—I think if the *takari* procedure were simplified and the borrower could get his loan more promptly, it might encourage their resort to Government assistance, and I think now, seeing the new legislation we have, they will probably resort to it more.

24. Q. What assistance is it reasonable for Government to render?—In Montgomery I don't think there is much chance of extension, unless canals are also improved and extended. There are many wells which receive no help from them. They depend for that on rain, and this is not a very profitable form of agriculture. Extension of well irrigation must wait upon that of canals.

25. Q. It is proposed that the Bari Doab canal should command that district?—Yes; mainly.

26. Q. The Shah Nahr canal in Hoshiarpur is under the Deputy Commissioner?—Yes, he has been formally appointed Executive Engineer under the Canal Act. So far as is practicable, distribution is largely done by the Manager. Though Government has taken over the canal, so far as is possible it is run by the people themselves.

27. Q. Would you suggest a greater interference on the part of the Canal Department in the canal?—I have noted points, but I think on the whole, as far as actual management goes, it would be better to run it on the present lines. When it comes to undertaking extensions—I mean substantial extensions—then I would suggest it being under more scientific control.

28. Q. It would be easy to leave a *zi* Engineer's services?—Yes.

29. Q. But would you suggest it being put under more rigid rules?—I think it is not necessary.

30. Q. Would it be popular?—I think not. The canal irrigation is not a burning question. Of course, we have a fairly good rainfall, so I think under the circumstances perhaps any further interference would not be advisable.

31. Q. You refer to a Minor Canals Bill?—That is a Provincial measure. It has been sent to us by the Government of India for amendment, and requires a good deal of redrafting. The main lines are to enable Government to assume the management and control of private canals under reasonable terms. It will be some time before it becomes law.

32. Q. You think something of the sort necessary?—Yes.

33. Q. Turning to your Montgomery experience, I see in paragraph 3 of your note you suggest, as far as your experience goes, that much could be done for greater security to irrigation by improved head works and weirs?—Yes.

34. Q. Of course, that would entail a very heavy outlay?—The weirs would, certainly.

35. Q. Are there any masonry head works?—Not to these canals.

36. Q. You say in para. 13 of your memorandum that the abandonment of wells is due chiefly to migration of tenants. Do you mean that the land goes out of cultivation till a new tenant is procured?—Yes. In the Chenab Colony there is a great demand for land, just as in Montgomery there is rather a great demand for tenants.

37. Q. The population is very sparse?—Yes, in the cultivation which adjoins the Chenab Canal. The Chenab Canal had great effect in taking away tenants.

38. Q. Then if the improvement of the Bari Doab Canal is carried out, would that remedy the state of affairs?—Yes, for a time; for tenants would pour into Montgomery. The shortage of tenants would still, however, continue until the tract filled up.

39. Q. It would throw the interior of the district into better condition; of course, there would be perennial irrigation?—I think tenants would be attracted away to the new canal.

40. Q. But, on the whole, the effect of the new canal would be to bring the greater part of the Central Bari Doab under cultivation. It would be doubtful whether the canal would pay?—As far as the district itself went, certainly.

41. Q. I suppose it would increase the food supply?—Yes.

42. Q. (Mr. Higham).—Do you think there would be any objection on the part of the people to the amalgamation of the water-courses proposed in your memorandum?—I think there would. Mr. Ballasie, the Executive Engineer, who undertook a good deal of that with a certain amount of success, met with considerable objection from the people. They like two water-courses, which prevent possibility of dispute.

43. Q. Whatever has been done, villagers have not had to pay for it?—Yes, they have, for those constructed at the cost of Government. These are village water-courses.

44. Q. When they are amalgamated, do villagers have to do them or Government?—It was just being undertaken when I left. I understood a number would be amalgamated. They were told in future water would not be supplied until this had been done.

45. Q. At their own expense?—With recovery, of course, from them.

46. Q. That would make it unpopular?—Yes, exactly.

47. Q. The inundation canals have suffered from the working of the Sirhind Canals?—I have heard complaints on that score. I do not know that it has been satisfactorily established.

48. Q. As far as the Bari Doab is concerned?—I can't say I have gone into the question very fully, but I don't think anything to a very remarkable degree as far as Montgomery is concerned.

49. Q. When were you settling the district?—From the beginning of 1894 to 1899.

50. Q. How did the irrigation of these canals compare with what had been recorded in the previous settlement?—There was an increase as compared with the previous settlement made in 1872-73.

51. Q. Do you know if there was an increase in the latter half of the settlement period?—I could not say without looking up figures. I think there was a fairly uniform increase. One has to bear in mind that the Lower Sohag and Para are new canals. Of course that would make comparison still more difficult.

52. Q. What is the extent of the salt land?—I could not say what the area is around Montgomery itself. There is a very considerable extent along the old high bank which bounds the central portion of the district and below that.

53. Q. It is called *reh*?—Yes.

54. Q. The salt would probably be washed out by irrigation?—I have not had experience of it, but without some sort of subsoil drainage it would not be washed out permanently; it would be washed down and with evaporation would come up again.

55. Q. Have you had any famine relief work in the Montgomery district?—Not in my time. There was a scarcity at the end of 1897-98, and an attempt at test works, but people did not come to them, and no famine relief works were opened. The people of the distressed part went across the river to the Chenab Canal where they either cultivated themselves or got temporary cultivation from Government.

56. Q. Mr. Wilson.—I see you estimate that the cost of a *pakka* well varies from Rs. 250 to Rs. 550?—Yes, taking the whole district.

57. Q. What is the average cost of a *pakka* well?—The depth varies very much. I should say from Rs. 250 to Rs. 500 in the riverain tracts.

58. Q. What would be the increase of produce due to the construction of such a well if commanded by a canal?—So far as the revenue rates go, the revenue would increase from 10 or 12 annas per acre to Rs. 1-6-0 or Rs. 1-7-0.

59. Q. You mean the net income of revenue to Government?—Yes.

60. Q. What benefit would Government derive in increase of land revenue from the construction of such a well costing Rs. 300 in such a tract?—I should say on an average, 10 annas an acre cropped to Rs. 1-6-0, that is speaking of the Sutlej Tahsils.

61. Q. What would be the area cropped by such a well?—Assisted by canal irrigation, on the average, from 25 to 30 acres would receive well water.

62. Q. The land revenue would be increased by Rs. 18; 12 annas would be an outside estimate of the average?—Yes.

63. Q. How soon would Government obtain that increase?—Not till the next settlement. A new well being constructed, the cultivation which got canal water would pay the canal rate, but would not pay anything more on account of well irrigation.

64. Q. Would Government necessarily get it at the next settlement and what about the protective lease?—It would not get it at all events until the current settlement had expired, nor until the expiry of the protective lease.

65. Q. Government would then obtain an increase of 18 rupees of land revenue from each well constructed by a private owner?—Yes.

66. Q. Are occupier's rates charged on the Sutlej canals?—Yes.

67. Q. Are they charged on the matured area?—Yes.

68. Q. Would the construction of a well lead to an increase in the amount realizable as occupier's rates by increasing the matured area?—Yes.

69. Q. Could you give any estimate?—I should not like to give one straight away.

70. Q. Land revenue rate is also assessed on canal irrigation; that is, on the area sown?—Except in years of widespread failure of canal supply or an extensive failure of winter rains. In that case it was arranged that remissions should be given for failed crops.

71. Q. Still, generally speaking, the canal rate is assessed on the area irrigated with the help of canal water, but increased by the construction of a well?—To some extent; because there would be a feeling that if a well is there, it would help to ripen the area sown.

72. Q. The construction of a well would lead to an increase of the area matured. The financial benefit the Government derive from it is not only Rs. 18?—Rs. 18 is an outside limit.

73. Q. What would you take as an average?—Put it perhaps at Rs. 15 to Rs. 18.

74. Q. And in addition to that there is an immediate increase, not inappreciable, from occupier's rates?—Yes.

75. Q. If that is so, it is a very profitable financial transaction to have new wells made?—Yes, where there are canals to assist.

76. Q. Would it not be financially profitable to Government to incur a certain amount of expenditure in order to get more wells made in such tracts?—I think so.

77. Q. Is there any difficulty in getting Government money to lend out as *fukam* advances. Is the grant, given by Government, sufficient for the advances desired?—As far as the districts of Montgomery and Rohtak are concerned, I have not experienced difficulty. At Hoshiarpur there is not much demand for well construction. In certain districts there has been difficulty, but I have not exact figures.

78. Q. Have you seen Mr. Laville's figures? The Punjab Government have cleared Rs. 40,000 a year on its *takavi* system. That is net profit to the Provincial Government. On the present footing, would it not lead to further profit if the amount granted were largely increased?—Yes.

79. Q. Would it not be advisable to reduce the rate of interest so as to absorb the net profit which Government makes?—Taking the total loans of all kinds into account, there is nothing available. There is a deficiency.

80. Q. In the Montgomery District you say that a number of wells have been deserted, especially on the Bari?—Yes.

81. Q. Do you think they will be taken up again?—I think that with the assistance of the District Board canals they might be set to work again.

82. Q. Is there much room for improvement in the Montgomery District?—On the Lower Sohag and Para there is considerable room for more wells in canal-irrigated land.

83. Q. If *takavi* were allowed without interest, would it add much to the extension of wells?—Yes. One of the main difficulties in the past about the wells has been that the *remindar* goes to his *baniah* for his domestic expenses, and the *baniah* with this grip on him compels him to come for agricultural loans also. I am certain, if he could get loans without interest, it would not be any the less inducement for him to go to Government.

84. Q. Do you think that on the whole it would be advisable for Government to grant *takavi* for the construction of wells free of interest?—As far as extension of cultivation and profit to Government go, I don't think there can be much doubt about it.

85. Q. In your statement here you say that the Sohag and Para canals have earned a net annual profit in the last three years of 10 to 14 per cent. Do you think that they are given sufficient credit for what they bring in to Government?—They have not in the past, but since the new assessment I think they get a fair credit for the income they actually create; and they should continue to do so, for the occupier's rates are revised from time to time.

86. Q. Are they given any credit for excess?—No.

87. Q. Should they not be given credit?—Yes, theoretically they should.

88. Q. As far as those two tracts are concerned, if it were not for inundation canals, there would be no cultivation at all?—No.

89. Q. The net profit of 10 to 14 per cent. is not an exaggeration?—No.

90. Q. It is a financial profit to Government?—It varies from year to year. Lately they have not shown a very high rate of profit.

91. Q. They are very profitable as a speculation?—Yes.

92. Q. In the Montgomery District do you think that canals could be further extended so as to give something approaching this profit?—Yes. There will be very keen competition. I mentioned this point in my financial memorandum. There is still a very considerable field for a fairly remunerative investment of Government money. But the canals have now to compete with perennial canals, and we can't afford to lose sight of the fact that an inundation canal alongside a perennial canal can't be as profitable as an inundation canal with a perennial canal nowhere near it.

93. Q. When you were settling the Montgomery district, had the Chenab canal been developed?—Most of the time. I was settling Montgomery at the beginning of 1894 and end of 1898.

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94. Q. As compared with things before, had the tracts improved or the reverse?—They certainly did not improve.

95. Q. Owing to what cause?—Largely owing to decrease in *Saizab* and still more to desertion of tenants and owners to the *Chenab* canal.

96. Q. There was a decrease in the *Saizab*?—Yes; largely due to the *Bari Doab* canal, but also, I think, to the channels of the river having straightened.

97. Q. What is the condition of the *Ravi* villages now compared with when you settled them a few years ago?—They have deteriorated still more.

98. Q. What has been done by Government to make this up to them in the way of assessment?—The assessment has been made more fluctuating. What fixed assessment there was has practically been abolished and canal irrigation has been extended to the high lands above the river, and I believe considerable grants of land have been given to the people on the Government land.

99. Q. Does that completely compensate them for the injury they have suffered from the opening of the large canals?—Yes.

100. Q. Does it put them in as good a position as they were before?—Probably—pecuniarily; but they (the zamindars) prefer flood irrigation and easy cultivation.

101. Q. Do you think that anything could be done to restore the prosperity of the riverain villages?—I think that, if the inundation canals, at present under the District Board, were improved, it would to some extent improve their condition.

102. Q. Is the District Board in a position to improve them?—I think not. From Mr. Kitchin's memorandum it appears that their income largely depends on fluctuating income, and it has fallen very low; the District Board is practically bankrupt.

103. Q. Is the Provincial Government likely to advance funds for improving these canals?—That depends largely on plague and famine, which have taken away all our surplus funds.

104. Q. Are there not sufficient funds for it from borrowed capital?—I doubt it.

105. Q. How many lakhs would be required?—It would be difficult to say. I doubt whether it would pay to borrow for the *Ravi* canals; for the *Sutlej* it would probably pay.

106. Q. (Mr. Rajaratna).—In the villages just referred to, when was the assessment revised?—The new assessments were revised in 1894, then I had to revise them again at the end of 1895, and even there then I have extended the area of fluctuating assessment.

107. Q. What reduction was made in assessment?—The fluctuating assessment depends on the area matured.

108. Q. What reduction was made in the rate per acre?—You can't consider the rate per acre; the actual arrears varies very widely.

109. Q. Was no relief granted?—A great relief was granted because the former assessment was fixed.

110. Q. What was the proportion of matured area compared to the former area on which the assessment was fixed?—In the *Gugera* Taluk in 1856 the cultivated area was 66,000 acres; at the settlement of 1872-1873 it was 66,000 acres; in 1896-1897 shortly after my revision it was 45,000.

111. Q. The assessment on these?—I have not got the figures just now. The settlement of the first was Rs. 71,000, at the revised settlement of 1871-72 it was Rs. 73,551, then it was Rs. 68,000. The second one is 48,000 acres, Rs. 68,400; on 6,000 acres no relief has been given. The Rs. 71,000 was fixed; the Rs. 68,000 was a largely fluctuating assessment; it was not a fixed assessment.

112. Q. I don't see what relief has been given?—The relief is in the elasticity. In the old system they paid whether there was a crop or no crop, subject to certain reductions in the case of continuous failure.

113. Q. (Mr. Ibbetson).—I understand what you really mean is that the area under cultivation has been decreased, not that the area actually cultivated has deteriorated; you give full relief as compared with the reduction?—Full relief as far as the assessment goes.

114. Q. Might you not go farther? The cultivated area which you settled at a fixed assessment included fallow, whereas the area on which you take your fluctuating assessment is the matured area?—The figures I gave were for that area. I have the fallow area as well.

115. Q. Mr. Rajaratna.—You refer to wells supplementing canal irrigation. Are such lands liable to pay the same rate as other lands not possessing the advantage of a well supply?—The land that does not have a well and merely depends on canal irrigation merely pays as far as canal revenue goes. If it has a well in addition, it pays canal advantage rate for the area over which the canal water is taken and something in addition for the well. I am taking the case of an old well in which the period of exemption has expired. Of course, if it is a new well dug during the term of assessment, up to the time when the protective lease expires, there can be no increase.

116. Q. Supposing he sinks a well two years before settlement?—He will then get 18 years before the new assessment is introduced.

117. Q. The assessment will be framed at the end of two years?—It will not be enforced until 18 years have expired.

118. Q. Are there many wells independent of canals?—Comparatively very few. I could not give exact figures. They are in what we call 'Bar' tracts outside the river valley.

119. Q. (The President).—I understood you to say the owner of a well in the riverain tracts depends on the canals, and, were it not for the canal, would not think it worth his while to make a well for irrigation?—That is the case.

120. Q. Can you give the number of wells in the 'Bar'?—I could not give exact figures; the wells are very scanty compared with wells in the riverain tracts that get assistance from the canal.

121. Q. (Mr. Ibbetson).—To come back to District Board management: Supposing the financial difficulty can be got over, would you then say that District Board management should be recommended or not as compared with the Government management as regards efficiency, impartiality, and popularity?—We should gain by District Board management in popularity, but lose in efficiency.

122. Q. By popularity I don't mean popularity with the District Board, I mean with the people?—I think we should probably gain; we should have to depend on the Deputy Commissioner being constantly in a position to supervise matters and settle disputes on the spot.

123. Q. Why should that be a more popular management?—It would certainly be a better means of irrigation.

124. Q. As to impartiality, have you ever heard anything as regards the distribution of water under District Board management? Is there a possibility of our man being better supplied than another?—I think there is a great possibility. It would have to be watched and checked very carefully.

125. Q. Have you heard any complaints of that sort?—I have not had practical experience of working a District Board canal. In *Hoshiarpur* I had complaints on that score, although, of course, many of them were without foundation.

126. Q. On the whole, would you prefer it or not?—I think there is a useful field for District Boards in the management of works which are not of any great importance. In a way, I regard a District Board as a pioneer.

127. Q. It is, I understand from Mr. Kitchin's note, in practical management far from successful. You will see a reference to this point in paragraph 9 of his note. Have they a very considerable area of irrigation?—Yes. The *Mamank* embankment came to grief in the last flood.

128. Q. How does the Deputy Commissioner manage? Is it nominally management by the District Board, but really by the Deputy Commissioner?—Yes. I ought to explain that Mr. Kitchin came to the district before I left.

129. Q. What legal powers have the District Board and the Deputy Commissioner in the management of the works?—None.

130. Q. Will the *Minor Canals Act* give them any power?—I don't think that the *Minor Canals Act* will be applied to District Board canals.

Mr. Wilson.—It was certainly intended that it should.

131. Witness.—The thing is at present rather in the air the *Act* is to be redrafted. At present it applies only to canals taken over by Government.

132. Q. (*Mr. Ibbetson*).—Is it advisable that legal power should be given?—Yes. I don't know whether it is necessary for District Boards to have very extensive powers, though they should have a certain amount of power in settling disputes.

133. Q. I notice that Mr. Kitchin condemns private management absolutely. Do you agree?—Yes.

134. Q. Why is it necessary that Government should take over private canals?—I think they should be taken over in the case of mismanagement.

135. Q. Do you think that any legislation giving an owner power to recover or allowing Government to recover for him is necessary?—It is not so much a question of recovery as of unfairness and quarrels among proprietors. There is a great diversity of interests. On the Mahdikhan Canal there is no difficulty in recovering dues.

136. Q. You say private *chars* are very numerous on the north of the Ravi; will they be superceded if there is large increase of irrigation?—There would be if these canals were extended.

137. Q. What is a *char*?—It is simply a cut from a river.

138. Q. When you say "private," do you mean owned by individuals or by villages?—Some by individuals and some by villages.

139. Q. Taken by men who have grants of land?—Yes.

140. Q. How do they work?—With a good flow from the river they have managed to do a very considerable amount of irrigation.

141. Q. Is the work of construction well done?—Yes.

142. Q. It is done cheaply?—The cash spent is not extensive.

143. Q. As regards maintenance, are there any difficulties about that?—No, the silt is cleared by the owner. Where the *chars* belong to the village, the length is distributed according to the level of the *chars*, and each shareholder is responsible for a certain length.

144. Q. Does that work well?—Yes.

145. Q. You have never heard of any pronounced difficulties about them?—Not on the private *chars*.

146. Q. Is there any outlay?—Very probably there would be a certain amount. It would be lessened by *takavi* grants.

147. Q. Do you think that, if Government extends irrigation from inundation canals considerably, the extension of the wells necessary to supplement it will keep pace with it?—There may be difficulty about capital.

148. Q. What is the life of a well?—Forty to fifty years with a certain amount of repair required in that time.

149. Q. (*Mr. Wilson*).—Are they built with lime and masonry?—Yes.

150. Q. (*Mr. Ibbetson*).—I suppose that, when the Lower Sobag and Para Canals were made, the same difficulty was experienced as regards the desertion of villagers. They went off to the better supplied lands?—I don't think there was any noticeable migration.

151. Q. You have no experiences to give?—In the years 1872 and 1873, when these inundation canals were taken in hand, there was a drain of cultivators from the Upper Sutlej riverain, but that had certainly righted itself when I came in 1895.

152. Q. In what tract?—In the Sutlej river.

153. Q. I think under the Punjab rules 20 years is the extreme limit of exemption from enhanced assessment on private improvements. Do you consider that sufficient?—I should say it was for the generality of cases. It depends on the cost of the well and the depth of the water.

154. Q. In exceptional cases is there power to lengthen the period?—I don't think so. I never came across a case of the kind.

155. Q. Supposing a man builds a well, what security is there that he gets his exemption?—The main security is that these are all revised at the time of assessment. A list of new wells is made out showing the date of construction and all particulars about it, and the fixed revenue is distributed.

156. Q. Does the system work successfully?—Yes.

157. Q. Is there not a similar exemption for tenants who have spent money?—Speaking of Montgomery, it is very rarely that tenants ever do spend money.

158. Q. With regard to the *takavi* rules in the Punjab, they only take security on the area to be cultivated?—Yes. There is no collateral security required.

159. Q. Has the security to be registered?—It is not formally registered. A memorandum is sent to the Registry Office and filed.

160. Q. He does not appear before the Registration officer?—No.

161. Q. Is there any provision for accepting the joint personal security of the owners of a village?—Yes, that is done.

162. Q. There is a provision for it?—It is very seldom done. But there is provision for it.

163. Q. Is there in sinking wells any great likelihood of failure?—No; spring wells are rare, and the supply being mostly by percolation from the rivers and from the canals, there is not much likelihood of failure.

164. Q. What do you think of the scheme of Government undertaking actual construction of wells and recouping itself by a rate on the area irrigated?—I think that is a matter for consideration; the arrangement would be fairly popular.

165. Q. Why do you think this scheme would be popular?—I don't think the *zamindar* would think much about it. He would have his well. I doubt if Government would be prepared to take it on.

166. Q. Well-irrigation depends very much on the supply of bullocks; in these years of drought has the well irrigation been restricted owing to want of fodder for the bullocks and the dying of bullocks?—Yes, in the case of wells that are not assisted by canals; that is one advantage of canal irrigation; it enables fodder to be grown for bullocks in the *kharif* without well irrigation.

WITNESS No. 2.—SARDAR GURCHARAN SINGH, Landowner, Hoshiarpur District.

Was examined by Mr. Ibbetson regarding the management of the Shah Nahr Canal in the Hoshiarpur District. Witness said that the private management had not been a success. There were constant disputes, and there was no increase of cultivation, so we handed the canals over to Government. There was not much trouble at first and while irrigation was confined to *khasdars* or shareholders; but when the canals were extended and *ghair-khasdars* or non-shareholders got water, they frequently refused to pay or delayed in paying their water-rates. The occupier's rate charged is Rs. 1-2 per 'ghuman' (½ acre), of which 8 annas is paid to Government for clearance and maintenance; 8 annas goes to the

shareholder; and 2 annas to the *maliks*. There are 400 or 500 shareholders and 3 *maliks*. No increase of irrigation is possible in the area now owned by the shareholders; it is nearly all irrigated. Any increase would be in lands held by non-shareholders. Except in dry years, there is enough water to allow of extension of command. Both shareholders and non-shareholders pay the same rate. The non-shareholders should pay more. Both Government and the shareholder would benefit by any increase in the rate levied on the non-shareholder. Shareholders would not object to extension, provided that, when water is scarce, they should have the first lion on it.

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WITNESS No. 3.—CAPTAIN J. G. CROSTHWAITE, I.S.C., Settlement Officer, Dera Ismail Khan.

Memorandum by Witness.

1. The Daman canals belong to two classes:—

(1) "Kalapani" or perennial flow from hill streams, mainly distributed by artificial channels.

(2) "Nuz" or flood water from hill streams conveyed in their natural beds and connected ravines.

2. (1) *Kalapani* or perennial flow.—The system of Kalapani irrigation is described in paragraphs 11–19 of the Final Settlement Report, and a further mention of the subject will be found in paragraphs 241, 243, 246, 388, and 389. This information, however, is partially incorrect owing to subsequent changes.

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The Tank Tahsil, which contains the most important Kalapani area, is much intersected by water-courses and ravines. The greater part of the former are natural channels. The Tank and Gomai Zame send their water down partly by artificial and partly by natural channels. But a flood may convert an artificial channel into a deep ravine, and a deposit of silt may reduce a ravine to a narrow water-course. The main channels are, however, fairly permanent; though as the "Noz" or flood water also enters them, they are liable to considerable change.

3. *Zam Gomal*.—This channel naturally tends southward, where it is known as the Luni. Near its debouchment from the hills its waters are caught by a dam and thrown into the Khanwad. Any heavy run of flood carries away this dam, and the whole supply flows into the Gandapur Circle. The Khanwad joins the Rod Narsae, a natural channel, in which it is carried until it reaches the Waran—a purely artificial channel—and the Kaur. The water is here divided between the two. The Kaur is described in paragraph 248 of the Settlement Report. The Waran crosses the Kiriani "Khad" or "Nullah," and the Kiriani aqueduct, built by Major Macaulay in 1881. Before the construction of this aqueduct, the Waran was not a perennial canal. The Waran, still proceeding north-west, passes under the Tank Road and ends down a distributary channel 40 miles to Dera Ismail Khan City and Centonments. The main channel then expands itself in a net work of small distributaries in the villages immediately beyond the Tank Road. Flow at head varies from 180 cuases to 30 cuases. The Waran in any heavy flood breaks, and its water is wasted. The lands on its left bank are some 6 feet higher than those on the right. This is due to the continuous deposit of silt above. If the second scheme referred to hereafter of building a weir at the Ratti Kumar be adopted, this lower area watered by the Zam could be also raised, and this constant danger averted.

4. *Zam Tank*.—The Tank Zam would, if left to itself, disperse its waters in six separate natural channels. Three of these—the Sidki, Chna, and Lohra—are used to distribute its Kalapani or perennial supply, and a supply of water is turned into each by a system of dams at the mouth of the pass. The three distributary channels, though natural to begin with, are carried on as artificial cuts. The flow at the head varies from 60 cuases to 20 cuases.

5. *System of irrigation*.—The system of irrigation from these channels needs some description. All cultivation is carried on in banded or embanked fields. Each village has a net work of channels leading from the main distributaries. Each circle has specific rights in the water, but the internal distribution is according to the revenue assessed on holdings and villages. The upper villages on the Gomai Zam receive a certain proportion each of the flow. The lower villages on the Gomai and all the Tank Zam receive the whole flow by turn for a fixed period each—a system known as the "roll" from the list of turns, or roll of villages.

6. *Other Kalapani channels*.—To the south of Tank the following Kalapani channels exist:—

Zam Daraban. | Zam Chaudwan.
Vehoa Zam.

These channels leave the hills immediately to the west of the towns whose names they are known by, and only irrigate the areas belonging to those estates. They are entirely managed by the owners of those estates, and rights in them are most complicated.

7. As regards the Kalapani system, there is little doubt that expert advice might suggest some improvements. But the rights in water and the system of cultivation would not allow of any general plan of improvement being adopted, even if it were otherwise possible. The further complication that the same channels carry perennial and flood water, with totally conflicting rights in each, has also to be met. If the present system be carried out carefully, and due attention given to each point as embanking the Waran, closing new kheds which have formed and preventing waste of water, there seems no necessity for special measures. The quantity of the supply decreases annually with the increase of cultivation within the hills, and the total area cultivated is not of sufficient value to allow of expensive measures. But if the Ratti Kumar scheme be feasible, the Gomai Zam could still receive a full supply. That scheme cannot aid the Tank Zam. The sketch map attached shows roughly the line of each Zam or Kalapani channel.

8. *Organization and records*.—The organization which carries out this system is described hereafter. It may be added here that while the rights and methods of distribution are

constant sources of dispute, yet full material and records exist for their disposal. Practically beyond these specified rights the Deputy Commissioner is the final disposer and organizer of the system. The staff maintained for direct supervision of the irrigation cost Rs. 2,886 per annum. The total area of arable land affected by the Kalapani in Tank amounts to 171,149 acres, of which 81,122 only is cultivated and the average area of matured crops amounts to 43,607 acres paying revenue in Rs. 77,104. The present cost of repairs done by zamindars and labour on dams may be put at Rs. 10,000 per annum.

9 (2) *"Noz" or flood water*.—The whole of the Daman, as the enclosed map shows, is covered with ravines and water-courses carrying the flood water from the hills to the Indus Valley. The Daman itself is hoist up out of the silt brought down by these. The system of dam irrigation is described in paragraphs 12–14 and 399–401 of the Final Settlement Report. The ravines or nullahs which bring the water down from the hills are known as "Rods." The most important from north to south are as follows:—

- | | |
|------------------|----------------|
| (1) The Takwara. | (3) The Luni. |
| (2) The Gomai. | (4) The Vehoa. |
| (5) The Gudh. | |

10. *The Takwara*.—This channel collects all the drainage from the semi-circle of hills forming the northern boundary of the Tank Tahsil. The catchment basin thus formed has a diameter of 2½ miles, and the whole length of the Rod is close on 50 miles to the point north of Dera City, where it escapes water falls into the river. For the first 20 miles of its course the main channel is wide and sandy, and much of the bed is cultivated. The dams on it are long, low ones which are used mainly to irrigate the *kuchcha* or low lands in or adjoining its bed; this usually lies much below the level of the surrounding country. On its reaching Takwara, the Rod forks and the right branch is caught by a bond, and an artificial cut taken out. This work is also due to Major Macaulay. The volume of water in this Rod is never large, and owing to the width and sandy nature of its bed the floods last a very short time. At present the lower villages have suffered very much from ravines which have formed during the last 16 years. But Mr. Geo had prepared plans for silting up these, and if these are acted on, the lower villages will improve a great deal.

11. *The Gomai Rod* issues from the northern end of the small range of the Ratti Kumar Hills. The old channel silted up, and Major Macaulay, in order to aid the villages injuriously affected, had the old Azina Kot Channel cleared, thus bringing a share of the Luni water into the Gomai. This has rendered the Gomai Rod of greater importance than it was at settlement. From the Ratti Kumar the Gomai flows 14 miles due east, and then in a more easterly course some 30 miles till its tail waters just reach the villages west of Dera City. Its main irrigation lies on the left bank. Very little land on its east receives water. It is closed by a succession of Gandis or dams of which the legal existence is a matter of record. The Gomai could with the Luni be vastly improved by the Ratti Kumar scheme, described hereafter in detail. The lower villages have here also suffered from ravines newly formed. A dam to be known as Gandi Dadrial in the south should prevent these increasing, and silt up those already formed.

12. *The Luni* (3) is the most important Rod in the district (see paragraph 383 of the Final Settlement Report). Until it reaches the Pailwal Dam, no irrigation is possible from it. The bed is up to this point of considerable width and depth. The Pailwal turns the Luni water into the mouth of the Shakh Roda, which passes north of Kulachi. Here the water is intercepted by a series of dams of which the first are Gatto, Barwala, and Khubzai. The Barwala dam is the old Roda Khula which had become a khad; and the water passes down the Khad Khobzai, and falls into the main channel below Sadd Brahian. From thence southward the Luni follows its old course, being held up at intervals by dams. Below Sagga, at Sadd Sakari there is a great danger of its breaking into the Sawan Rod on its south. Seventeen of the 30 dams are regarded as directly under Government so far as their management is concerned. The others, the villages themselves arrange to construct. The main scheme to improve this Rod would be the Ratti Kumar one. There are also a bed series of ravines in the south which need closing in Tikkan and to the south of Khutti. The Rod is in all some 56 miles long. Its sources lie outside the district.

13. *Remaining hill streams*.—Of the remaining hill streams the Vehoa is the only one of much importance,

The "Kalap" in it reaches Vehoa only, and that estate receives no flood irrigation. So long as the Rod runs above the old bank of the river, Jalluwali alone receives irrigation. East of the "Knr," or old river bank, the Rod turns southwards and its waters are held up by a series of low dams. It finds its way into the Dera Ghazi Khan District, with which the tract it waters is now to be amalgamated. The Gudh is also a stream that needs mention. It has hitherto not been worked to advantage. A new dam planned by Mr. Geo close to Minsazai would much improve it.

14. *System of "Nuz" irrigation.*—The system of irrigation with "Nuz" water is as follows:—

From above each dam "Khuls" or small channels which feed the village systems of irrigation take off. Each village manages its own internal distribution and the construction of the Gundi on which that system depends. The irrigation records contain elaborate provisions for every possible contingency. The general arrangements, however, rest entirely in the Deputy Commissioner. He has to arrange for the re-erection of dams, frequently in the flood season itself. All large dams which affect more than the mere irrigation of a single village or which are protective works are under his immediate control. He fixes the date of building, and arranges for supervision, the number of yoke required, and alters the village quotas if necessary. But the management of smaller streams is left largely to the villages themselves. It is, however, a recognised principle that the Deputy Commissioner has the right to interfere in every case of dispute, and to pass final orders on the matter. It is also his business to order dams to be cut when necessary. In theory each village in turn has the right to hold up the water until it has finished irrigating. This is known as the "Saroba Pains" rule. In practice the Deputy Commissioner decides when the dam should be cut. His powers in this matter are necessarily deputed to some extent to his Revenue Extra Assistant Commissioner and Tahsildars. The Saroba Pains rule is in force on all Rods except the Kot Azim-Gomul. There Major Macaulay introduced a new supply of water, and was unable to follow the rule in its distribution. Paragraphs 399—401 of the Final Settlement Report can also be referred to for further information as to management.

15. It has been necessary to enter into some detail as regards the system in the Daman and the Deputy Commissioner's share in it. It is probable that expert advice from a Canal Officer would enable the general scheme of irrigation to be improved. But under the existing circumstances no one but the Deputy Commissioner is in a position to control the turbulent upper villages and to arrange for labour in a country which is often deserted at the very time labour must be found. Major Holmes, R.E., in his note on the irrigation schemes mentioned in the next paragraph, distinctly advises that the supervision and total management of the irrigation arrangements be left to the district authorities as soon as the new work was carried out.

16. There have already been two schemes proposed for the improvement of the Daman irrigation (see paragraphs 402, 403 of the Final Settlement Report). Mr. Tucker in the two paragraphs cited gives the details of the two schemes and their cost. I regret that I have been unable to trace Mr. Garbett's original proposals. Presumably these are to be found in the Financial Commissioner's Office or in the Irrigation Department. The schemes appear to have been dropped; but on what grounds I am unable to say. Both are feasible, and if anything is to be done, the larger scheme, which includes the other, should be undertaken. I regret that in the short time available I have been unable to go into the matter very fully. The Kot Azim Cut leading into the Gomul now irrigates some portion of the land then available for the new scheme. Some direct increase would result in the revenue if the Kalapani was brought under full control. This would, however, be a trifle compared with the cost of the upper works. But the advantages of the whole scheme would appear to outweigh it, at least, a careful consideration on the spot by a Canal Officer. It would undoubtedly allow irrigation to be more successfully managed. Mr. Tucker's estimate of the fitful flow of the Luni goes somewhat beyond the truth.

17. *Local water measure.*—I regret having again to go into detail; it is necessary. It must be premised that the local measure of water is a "jandra" or sufficient water to work a water-mill. The nearest approach to an accurate measure is that a jandra of water will give a foot of water to 5 acres of land in 12 hours. But the local rainindar can state any quantity of water seen flowing in a channel he knows in jandras. Nor will different men's estimates materially differ.

18. *Supply available.*—During June, July, and August the flow of the Luni is estimated at 300 jandras per diem, or sufficient to irrigate 30,000 acres per diem at its head. With the large obstructions used for the conveyance of this water there is very great wastage. The flow follows a dry period up to January. That month and February may be calculated at 20 jandras per diem only. In March and to 15th April the flow rises to 30 jandras.

19. *Crops raised.*—The main crops grown are cotton melons, bajra and wheat. For the first two one watering in March or April and one in June or July are sufficient. Bajra needs two waterings in June and up to the 15th August. If these are followed (on the Luni or Takwara) by one more watering, wheat can be successfully grown on the same plots. It will be seen therefore that for the present system of cropping water is only needed at certain periods. If the supply could be controlled at the Ratti Kumar Range, there would be every prospect of a great extension of cultivation. At present cultivation is speculative. A second watering may be obtained, or a heavy flood sweep away the dam and no water be available. The control of the supply would allow of the proper irrigation of each village in turn. It is impossible without careful enquiry to make any exact estimate of the possible increase in cultivation. As all the land affected is arid, or will be under, a fluctuating assessment, this increase will be a direct gain to Government and to the people. It is true that the reservoir would be eventually silted up. The amount of silt in suspension in the "safed pani" or hill torrent water is very great. It is by no means uncommon to find a village site, protected from the flood water by embankments, becoming hidden in a hollow, since the silt deposits raise the level of all the surrounding land. But if this were to happen, the main channel of the Luni would still be kept clear by scour. Further, any marked deposit of silt to the north of the Ratti Kumar would damage some 7,000 acres of waste in the Gomul estate, and 2,500 in that of Ghorezai into most excellent land. The lower villages could well spare a deposit of silt if they received sufficient water. I should add that the original scheme proposed a reservoir of great size. I do not believe any reservoir to be necessary. What is required is a retaining weir at the Ratti Kumar Range which would allow the flood water to be properly divided among all the channels below. This would entail making a distribution canal parallel with the hills to the south. But it may be found that this scheme would cost much less than that originally proposed. A proper distribution of the water is all that is needed. There would be no necessity to build up the entire flood.

20. *Establishment.*—The present establishment is paid for by a cess of 3 per cent. on the revenue and partly from the proceeds of fines. Mr. Geo in his report No. 59 C, dated the 16th August 1899, to the Commissioner of the Peshawar Division, dealt fully with the subject. That report has, I believe, been printed in the Proceedings of that year on the introduction of the Peshawar Canal Regulation into this district. The cost of the staff amounts to Rs. 3,258. The annual cost of the labour expended on the dams may be placed at Rs. 45,000, but this is a low estimate, and does not include any dams but dams on the main channels. The area supplied by the Luni and Gomul Rods which would be affected by the new supply, or improved irrigation arrangements, amounts to 698,177 acres. Of this 503,021 are arable, and 155,409 actually cultivated. But the average area sown only amounts to 114,648 acres, of which 70,098 acres mature paying revenue in Rs. 87,531. It is believed that with proper control over the water fully 200,000 acres would be under cultivation every year, and that the area matured would greatly increase. The gain in revenue would not be less than Rs. 1,00,000.

21. *Whole Daman.*—The total area of the Daman is 1,058,453 acres. Of this 1,361,678 are classed as arable, and 438,753 are under cultivation. This last amount includes 94,656 acres of Kalapani cultivation, and 143,551 of nuz or rodkahi cultivation. The remainder are mainly pure rain lands lying out of reach of irrigation. Since last settlement there is a decrease of 62,000 acres in the area cultivated. But the last five years, on the average of which these figures are based, have been very bad ones. There has undoubtedly been a serious decrease in the Kalapani crop.

22. *Cis-Indus. The Indus Valley canals and the advisability of constructing inundation canals.*—The Bhakkar and Leih Kauchli irrigation system is described in paragraphs 24 and 25 of the Final Settlement Report. That description is still fairly accurate. The Kauchli Circle or low lying Rot lands receive far more irrigation than they require. The Pakka Circle which contains the high lands

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lying under the Thal bank, or Dhaia, is the only part which ever needs aid in its irrigation. The main channel which irrigates the Pakka is the Puzal, Lahu, or Bodho, as it is variously known. At present the set of the river is towards the east bank above its head, which now lies almost opposite Darya Khan. The main river has cut into Kalurkot and sends a full supply, known as the "Kallari Chhal," down the Andhana or Mora-sun Nullah which lies directly under the Dhaia. This small nullah has a large number of small bunds or dams erected on it, and the "Saroba Paina" custom prevails as in the Damán. On the Lahu or Puzal the dams do not begin till Machcharwali, some 4 miles south of Bhakkar. These dams are larger and usually need the supervision of the Tahsildar. A fixed quota of yoke for each village affected by the dam is laid down. In years of high flood these dams are always carried away, or out to relieve the villages above them. But in years of low flood they are necessary for the irrigation of part of the higher lands in the Pakka. In ordinary years the dams should not be cut, but the water led round through the net work of nullahs into the main channel below the dam. The system works easily and without much annoyance to the people. There are a few partly artificial cuts, usually made by digging out some existing channel. A small establishment is kept up costing Rs. 628 per annum. The annual cost of dams and labour generally does not exceed Rs. 5,000. The average area cultivated amounts to 167,668 acres. Of this, however, 53,614 are aided by wells; 2,669 wells are in use and 778 jhaldrs or persian wheels worked on pools or back waters of the river. The average area per well is 16 acres. The average revenue is Rs. 1,47,606.

23. *Kot Sultan Canal.*—In the extreme south of the district the Kot Sultan Canal, which is under the management of the Canal Department, takes out of the Budho. The Thori Nullah is also dammed to supply the Kot Sultan. The construction of this canal head in this district has led to considerable trouble from zamindars whose water rights had suffered. A *modus vivendi* has, however, been agreed on (Revenue Secretary to Government's No. 76 of 20th April 1899 to the address of the Financial Commissioner). This canal does not affect this district at present.

24. *New inundation Canals.*—So far as an unprofessional estimate can be made, it would appear quite needless to add to the irrigational advantages of the Kachha Circle. As regards the Pakka Circle, it is believed that the Budho-Puzal Nullah could be turned into a more effective canal. At present some of its branches contain water all the year round. The survey of the river-bed unfortunately does not contain any levels on which to base a rough plan. But as the stream at present lies, the head of the Puzal would have to be thrown out. At various times, when the set of the river has been towards the east, bunds or protective embankments have been thrown up roughly outlining the Pakka Circle

boundary. These have been limited to particular villages attacked and have never received any general shape. If a perennial canal were possible, it would probably be necessary to exclude the floods, which now in two years out of seven cover the whole Pakka Circle. In any case it is considered that an extension of the present Kot Sultan Canal to a point 10 or 15 miles north of Lsiah is feasible. But a Canal Officer would probably be able to decide at once the feasibility of either scheme. As regards direct increase of revenue, if the canal is a purely inundation canal, there is some doubt. A much larger area might be secured in years of short flood, however. It should be remembered that the expenses now incurred by zamindars on their irrigation system are very small. There is no heavy or elaborate "ohher" or labour system which could be replaced by any water-rate.

25. *Proposed Permanent Canal.* *Possibility of perennial canal reaching Jhandi Thal in south.*—It is hoped that any scheme for a perennial canal taking off much north of Lsiah would enable the lower or Jhandi Thal to receive irrigation. Though the Thal lies far above the Kachchi (20 feet) at Darya Khan, the difference falls rapidly till in the extreme south high floods have penetrated into it.

26. *Trans-Indus.*—The Kachcha Circle may be regarded as disposed of under "Cis-Indus."

The Pakka Palarpur Circle is irrigated by several small artificial cuts as well as by flood irrigation in the old bed or "Puran." (See paragraph 23, Final Settlement Report.) These cuts, such as the Khos Chaha, Tuckervah, etc., work very well if the set of the river is towards them. The main stream has now left them, and it is probable that it will be necessary to extend their heads. These are worked on the usual lines with dams, and the Saroba Paina rule applies to them. A small establishment of Rs. 261 per annum is kept up. The supervision is really done by Revenue Officers. A very full and detailed account of the system is contained in Mr. Geo's report No. 81, dated 8th February 1900, printed as No. 12 of Revenue and Agricultural—Proceedings for September 1900, Nos. 10—16. I entirely agree with the late Mr. Geo's recommendations. His knowledge of the irrigation arrangements of this district was in every way most beneficial to its people: and his loss almost irreparable. If the scheme is accepted without the recommendations as to trans-Frontier settlers, it should prove a profitable one. Full provision must, however, be made for the initial survey. The District Board will have no funds available for the purpose. It may be noted that the scheme will supply 81,642 acres of cultivable land with canal water, and should bring in a considerable increase in revenue. No estimate of the cost of the scheme has yet been made. The initial survey, to cost Rs. 18,000, has, I believe, been budgetted for in the new financial year.

1. *Q. (The President).*—I understand you are Settlement Officer of the Deru Ismail Khan District?—Yes.

2. *Q.* How many years have you been there?—Three years.

3. *Q.* Have these years been a time of drought?—Almost entirely. In the Damán there has been only one decent harvest the whole time.

4. *Q.* What is the annual rainfall?—About 6 inches.

5. *Q.* When does it fall?—About 2 inches in the cold weather and 4 inches in the hot weather.

6. *Q.* This helps to sustain the cultivation?—It is rain outside the district that affects us, the rain in the hills and also the amount of snow at the source of the Indus.

7. *Q.* Have these failed in the last few years?—There have been short drops, but the pinch was much less felt than in other districts. Failure of the rains inside the hills affects the Damán. Excessive rain produces heavy floods which destroy the irrigation dams. In the Indus Valley heavy and long standing floods give a larger rabi harvest and small kharif. A short flood increases the kharif area, but leaves little moisture for rabi sowing. Rain is essential to the ripening of the rabi.

8. *Q.* Please describe the system of irrigation?—There are two systems of irrigation from the perennial streams: a small valley leads into the Gumal pass and there the irrigation is done in small plots. Below that the embanked fields are flooded.

9. *Q.* Is the country pretty flat?—The whole tract is a tilted plain. There is a regular system of distribution from the streams; the fields are embanked and water let in by small distributaries; the water is run along between the tops

of the embanked fields, each man fills his field to a depth of about two feet and then closes the channel. When the water has subsided, the field is ploughed, that is in June, July, and August.

10. *Q.* Does the cultivator arrange for this?—In the internal distribution the village looks after itself. As regards distribution among villages, there are very elaborate water-rights, and these are recorded. The statement of water-rights also goes into minute detail of individual rights in the case of the perennial supply. The upper or plot irrigation is divided on fractional shares of the flow. The lower cultivation receives so many days' or hours' flow in rotation.

11. *Q.* The cultivators practically look after their own irrigation?—No, we have a staff which sees that each village gets its turn at the proper time. Inside the village they do look after the distribution themselves once the water has been given to it, but if one man overrides the rights of another, the case comes for decision to the Deputy Commissioner.

12. *Q.* Are there District Boards?—They have nothing to do with irrigation; at one time there was a committee which managed the irrigation, but it was badly done and it was abolished at the request of the people themselves. It was found impossible to allow irrigation to remain in the hands of the zamindars themselves. It must be controlled by the Deputy Commissioner entirely.

13. *Q.* It has been said that the supply is lessening owing to the increase of cultivation in the upper valleys?—Wherever a British post is established, cultivation extends in its immediate vicinity and then a good deal of water is absorbed that used to reach the people below.

14. *Q.* Is there any possibility of storing water in reservoir or tanks?—You can store drinking-water. There is

also a scheme known as the Ratti Kumar. There is a very large supply of water available in the flood water or spills from the hills. This passes through a small range known as the Ratti Kumar, where its control would be possible. We want to control it. This will require a weir. A scheme was prepared for the construction of a weir 20 or 30 feet high at a cost of 5 lakhs so as to store the supply for the country below. What we want is to control the supply and direct it on to the country. A weir 12 feet high would do. It is a fertile country, and no manure is used.

16. Q. Was there much distress during last drought?—Yes, but our people in the Daman are accustomed to a hard life. They expect one bumper crop in 3 or 4 years. When good crops do come, I have seen 25 to 30 mounds of an acre. In the intervals they live as best they can.

16. Q. You had no relief works?—No; but there is a certain amount of work always going on in maintaining the system of irrigation.

17. Q. You do not consider it necessary to have a scheme of relief works for possible future famine?—Yes, I do; you cannot tell what may happen.

18. Q. Have the Public Works Department drawn up a scheme?—Yes, but it does not include any really useful works. Mr. Gee had a number of schemes which we are inclined to take up now. These schemes were all for the direct improvement of the flood irrigation system or for the prevention of injury to existing areas of flood cultivation.

19. Q. You say that in the Daman there are 1,458,000 acres, of which 1,301,678 are classed as cultivable?—Yes, it comes under cultivation one year or another. The average cultivated area is 435,753 acres, but the area actually sown is only 310,785 acres, of which 212,111 acres alone mature.

20. Q. Could the area be increased?—Yes, if there were more water. Under the present system, a village may lose its turn by a dam being carried away. Control of the supply would increase the area cultivated, and also ensure a much larger proportion of matured crops.

21. Q. How far apart are these dams?—Usually a mile apart, but at important points several dams may be close together.

22. Q. Have you any suggestions to make for improving the system?—I propose that an experienced Canal officer should review the Ratti Kumar scheme; and also a scheme for a small weir at the mouth of the Gomul. There is also the Paharpur scheme for converting an existing inundation canal from the Indus into a perennial canal and carrying it as far as Dera Ismail Khan.

23. Q. How much would this canal irrigate?—The increase in area would be about 50,000 acres. The area commanded by the Khush Chakra and the Tuckeria would also be increased. These schemes would command an additional 150,000 acres if all were carried out. They have not been examined by a qualified professional man.

24. Q. Is there any well irrigation in the district?—In the Kachehi or low land, there are 238 wells. In the Pakka or high land there are 2,559 and 775 ghals. The irrigation of the Pakka is supplemented by floods. The Kachehi is irrigated by river flood alone. In the Thal, or great sandy tract between the Jhelum and Indus, there are over 2,000 scattered wells which are sometimes 6 to 7 miles apart.

25. Q. Are these masonry wells?—Yes, entirely.

26. Q. What is the depth to spring level?—Fifty-five to 80 feet in the Thal. In the Kachehi 10 to 15 feet.

27. Q. How much does a well cost?—In the Kachehi Rs. 200 to Rs. 250. In the Pakka and Thal Rs. 50 to Rs. 600.

28. Q. What are the prospects of extending irrigation from wells?—I doubt if there is much possibility of extension in the Thal, where wells are expensive. In the Kachehi there has been an increase of 52 per cent. since the last settlement, and there is no reason why there should not be a further increase.

29. Q. Is the Kachehi a large tract?—Roughly a million acres, the average area cultivated is 332,285 acres. The district covers 9,400 square miles.

30. Q. What is the population of the district?—100,000 to 500,000.

31. Q. Is increase of wells in the Kachehi due to *takari* advances?—Not to any great extent. The cultivators go to the *bania*. An insufficient period is allowed for repayment of *takari*, and the advances cannot be obtained without a great deal of trouble and expense. The recovery of instalments leads to further trouble.

32. Q. The rate of interest is 6½ per cent.?—Yes, the *bania* charges the same rate to large zamindars who are known to be solvent. *Captain Crosthwaite.*

33. Q. (Mr. Ibbetson).—Has the *bania* any object in conciliating the borrowers?—No. *28 Oct. 01.*

34. Q. (The President).—Can you suggest any procedure to simplify the system of advances by the State?—The period for repayment should be more elastic. If a man's crop fails, he should not be asked for his instalment. I do not think that reduction of interest would have much effect.

35. Q. What period would you allow for repayment?—Fifteen to 20 years.

36. (Mr. Wilson).—It is already 20 years.

Witness.—Certainly that period is not ordinarily allowed.

37. Q. (Mr. Ibbetson).—Is that not the fault of the officer?—I have always thought it was not permissible to allow so much.

38. Q. (The President).—You think 20 years sufficient?—Yes, the period usually allowed is 10 to 12 years. I do not like the system on which loans are given. The money should be given out by the Deputy Commissioner or his Revenue Assistant while on tour and on the spot. A man should not have to come in and apply at the Tahsil.

39. (Mr. Wilson).—The new rules give further facilities in this respect.

Witness.—I have not yet seen them, having just returned from leave. If a Tahsildar or other subordinate is entrusted with the arrangement of *takari* grants, he feels responsible to Government, and his first consideration is to make the loan perfectly safe and to obtain the best security.

40. Q. (Mr. Ibbetson).—Supposing this difficulty could be removed, would the money be taken largely in the Kachehi tract?—Yes; if big zamindars were used in the distribution, and the minor Tahsil officials, chaprasis, and moharrirs were not allowed any opportunities. Lists of suitable men for grants should be prepared by the big zamindars or by committees of selected zamindars.

41. Q. You would leave it to them and have nothing to do with the details?—Yes; I would simply see that the money was paid back in so many years.

42. Q. (Mr. Rajaratna).—Would not the zamindar want something for his trouble?—No; our men are Mahomedans, and a large number of the loans would go to their trilemen. It would be a disgrace to ask anything from them.

43. Q. (The President).—I find from Mr. Gee's letter to the Commissioner of Derajat (No. 81, dated 5th February 1901) that it is a great pity that inundation canals Cis-Indus have not been introduced?—Cis-Indus there are two classes of land—high land and low land. In the low land it is not easy to give them more irrigation. The low lands are completely flooded every year. In the higher lands known as the Pakka, in two years out of five there are floods up to the edge; during the remaining three years flood irrigation is effected by an elaborate system of creeks and nullahs. It is flat land lying a little above the river. At present in a low year at certain points of these creeks small bunds are put up to hold up the water. These are cut periodically and the water passes down to the villages below. Sometimes, instead of cutting the bund, the supply is passed round the village to the village below.

44. Q. Why is this not always done?—The Deputy Commissioner's attention in the past has been devoted to frontier matters. Access to these villages in flood time is a matter of great difficulty.

45. Q. Now that will be remedied?—Yes, Mr. Dempster, who was a great expert in canal matters, thought the water of the Badhan Nala could be utilized in an inundation canal joining the Kot Sultan canal. He asked me to work up the scheme, but I would have nothing to do with it if it involved levying a water-rate as he proposed. The expenses of the present system are very small. All the zamindar has to do is to repair the bunds at small cost; and there is very little money payment.

46. (Mr. Wilson).—You say that the *kulupani* or perennial supply shows signs of diminishing owing to extended cultivation in the passes above?—Yes, it has diminished by 30 per cent.

47. Q. Do you think this diminution will increase?—Yes up to a certain point. There is a great deal of land available, and wherever we put down a post, people cultivate all round it.

*Captain
Crosthwaite.*

29 Oct. 01.

48. Q. Is it possible or desirable to try to prevent that diminution?—It would be very hard on the people. You cannot prevent it because according to their own laws those higher up the stream have first rights to the water. The irrigation is changing from perennial to flood irrigation. At settlement perennial cultivation was 102,499 acres; it is now 94,656, and it may drop to 60,000 acres unless a weir is put into the Gmral pass which would prevent a good deal of the present loss of water. If the Ratti Kumar scheme is carried out, extra water can be thrown into the Gmral and there will be no question of shortages of water in that channel.

49. Q. Are these villages that are suffering from diminution of perennial supply also irrigated by torrent irrigation?—Yes.

50. Q. These villages will continue to deteriorate owing to the diminution of the perennial supply?—Yes; there are two perennial streams. One supplies the Tank Zam tract, 119,999 acres, which is dependent on it. This stream would receive no aid from the Ratti Kumar project. The other irrigates 120,281 acres, and would receive a great deal of aid. There would be no diminution in the area cultivated, provided the Ratti Kumar scheme were carried out.

51. Q. Does not a large amount of water flow uselessly to the Indus that might be utilized for torrent irrigation?—Yes; in years of full flood.

52. Q. There is a large area of land that might be irrigated by the water lost?—Yes; nearly 2 million acres, in all of which 1,861,678 acres is now classed as cultivable. Control of the irrigation would cause many of the ravines to silt up and increase this cultivable area.

53. Q. There is both land and water?—Yes; but it is a question whether we can control the flood supply—generally for three months of the year we find it uncontrollable.

54. Q. What financial benefit would Government derive from the development of the irrigation?—An increase in the fluctuating revenue. At present no rate is charged for the water apart from the land revenue, except a small cess to meet the cost of a small establishment. In some cases this is levied in kind.

55. Q. In the case of cultivation dependent on torrent irrigation how far is the assessment fixed or fluctuating?—In the perennial tract out of Rs 89,803, Rs. 80,866 is fixed. In the Rodkoli or torrent tract out of Rs 1,87,863, Rs. 74,250 is fixed; but in future almost the whole of this will be fluctuating. Most of the villages under fixed assessment have asked to be put under fluctuating assessment.

56. Q. Do you propose that it should be entirely fluctuating?—Yes.

57. Q. If that proposal is accepted, how much land revenue will depend on torrent irrigation?—Rs. 2,38,221. The revenue will rise or fall as the irrigation system is properly worked or not. I have seen a loss of Rs 80,000 in one year owing to bad management.

58. Q. Government will now be directly interested in the management?—Yes; Government will benefit by every extension of irrigation.

59. Q. Does Government at present depend anything on the system?—No, nothing; except a share of the time of the Deputy Commissioner and officials. Under him I believe that well directed expenditure on dams and protective embankments would be directly remunerative in the increased fluctuating revenue derived. Funds should be placed at the Deputy Commissioner's disposal for this purpose, and he should have the benefit of expert advice during the winter.

60. Q. Although it benefits largely from improvements in the system?—Yes.

61. Q. It would be impossible to substitute the system of realizing anything like occupiers' rates and getting this work done on cash payment?—It is doubtful whether any system of cash payments could be substituted. Any rate on the matured area might work badly. Much more labour is often needed to give irrigation to the same area in one village than in another.

62. Q. Could the people be induced to organize labour on these embankments without the help of Government officers?—No, except in very few villages.

63. Q. The organization is done by the Deputy Commissioner and Tahsildars?—Yes.

64. Q. There is no staff to assist in organizing this labour?—A very small establishment: it is mostly taken up in reporting and carrying out routine work, they have nothing to do with the internal distribution of water.

65. Q. Is there not a want of continuity in the administration?—Yes.

66. Q. Would it be a great advantage to Government and the people to have a continuous system of supervision, say an Engineer Officer or an Extra Assistant Commissioner so as to keep up continuity?—Yes; an officer of the grade of Extra Assistant Commissioner kept there for some period would be beneficial; it is impossible for the Executive Engineers to give the time; he is occupied with public works buildings and roads and innumerable other projects; if a canal officer could come during the winter and look over the schemes and see what improvements were needed, and what bunds should be looked after, his presence would be beneficial: for the greater part of the year there is no work for him there.

67. Q. Would a stranger to the country be useful?—No.

68. Q. Have levels been taken of the district?—No; except along main Luni channel and the Tank-Dera road. Single lines of levels like these are often misleading.

69. Q. Would it not be an advantage to have levels taken?—Yes, undoubtedly.

70. Q. Would the District Board be able to pay for it?—No, they are bankrupt.

71. Q. Is it worth the while of Government to carry out a survey of levels within the immediate vicinity of the main channels?—No, the zemindars will point out the exact line along which a cut should be taken. But it would be advisable to get a general knowledge of the lie of the country. The heavy silt deposits kept within artificial bounds render levels taken close to the main channels very misleading.

72. Q. You said that Government would directly benefit by any increase in the fluctuating assessment of the revenue; in that case would it not be worth while of Government to incur some expenditure in securing an increase?—I think it would be advisable for Government to spend five to six lakhs of rupees, the present area under cultivation would be doubled in two years, and the proportion that matures would be very much increased. It very often happens that only the villages at the top gets water which, owing to flood and other causes, does not reach those lower down; at present out of 200,410 acres sown only 125,687 matured. That is a very large proportion of failure: the crop that failed would have matured if water had been available.

73. Q. In the case of a fluctuating system of assessment, would the land revenue to Government increase in proportion to an increase in the area irrigated?—Yes, at present every acre that fails pays nothing at all. Every acre matured pays a rate according to the crop grown. Better irrigation would ensure wheat and cotton replacing less valuable crops, greater certainty of irrigation would enable Government to realize something nearer its proper share of the produce. Assessments at present have to be pitched very low.

74. Q. Is there any legal power vested in the Deputy Commissioner to compel a village to labour on these embankments when it is not inclined to do so?—There are very elaborate provisions on the subject which have been looked upon as binding, but the question of the legality of the orders will probably be brought under consideration.

75. Q. Has it been questioned?—No; from time immemorial, certainly from the time of the Sikh Governors, the control of the irrigation has lain in the hands of the local authorities. All disputes and questions affecting irrigation between villages and individuals have been settled by the Deputy Commissioner with the Commissioner as a court of appeal.

76. Q. It is doubtful whether they have legal authority?—It has nowhere been laid down nor legislated for, but no zemindar has questioned it.

77. Q. There has been no practical difficulty?—No.

78. Q. In carrying out the improvements and schemes referred to, would not one of the chief difficulties be the danger of silting up any channel or embankment that was brought under control?—Yes. The silt deposit is very heavy. I know some villages which have been absolutely buried in silt; till you get within 100 yards of the village, you cannot see it. After 10 or 15 years' deposits, you are able to look down into a hollow surrounded by the 20 to 25 feet of silt which has been deposited. The villages are surrounded by embankments which are raised year by year as the silt deposit increases.

79. Q. In Muzaffargarh there is a fully developed system of inundation canals?—Yes.

80. Q. And none in Dera Ismail Khan?—There is a boundary fixed by the Thal beyond which irrigation cannot extend. In the south of the district if an inundation canal were made, much could be brought under cultivation. In the upper lands there is no possibility of extending irrigation, since every two years the whole of the strip is flooded.

81. Q. Has any system of levels been taken there?—No; not in the river bed. There are levels taken just outside the valley on the edge of the Thal.

82. Q. Is not the system of land revenue assessment in this valley a fluctuating system?—Yes, almost entirely.

83. Q. By the expenditure of capital on inundation canals, could not the land revenue of Government be increased?—Yes.

84. Q. Without any delay?—Yes.

85. Q. If *takavi* were offered without interest on a simple system, if, say, Rs. 300 was advanced for a well which would be repayable in instalments, would that not be an inducement to the people to take it?—Yes, it is most important to arrange that the money should be easily got, no elaborate system of accounts and no hindrance of people wanting to get the money.

86. Q. Another reason of the unpopularity of *takavi* was, you said, the rigidity as regards repayment?—Yes, I don't mean that; it is the intention of Government that these bonds should be recovered in the way they are, but it is often the case now that a man is eloped into the *haralat* until he pays. This is less the case with advances for constructing wells.

87. Q. In the case of *takavi* for wells would not the rigidity be removed if instead of giving a protective lease the full land revenue were to be realised for the 20 years and the irrigator to pay according to the crop matured every year?—Yes.

88. Q. (Mr. Ibbotson.)—You say if you could get control of the water of the Luni and Gomul channels you could bring an additional 85,000 acres under cultivation; would you have the people, manure and cattle to work that?—I don't think the number of men are wanting—we should have to buy our cattle from the south. No manure is used or needed in the Domán.

89. Q. Do you think the men and cattle would be available?—Yes, but it would take some time. Our birth-rate is low because the people have had a hard time. It might take six or seven years to bring in settlers and colonise the tract.

90. Q. On the frontier the system of irrigation is not entirely on a legal basis; do you think the time has come for legislation?—Yes.

91. Q. (Mr. Higham.)—If you are going to make this Ratti Kumar weir, I suppose the money will come from Government?—The money to meet the cost of the weir must be paid by Government. But our dams would stay up year after year; if we had control of the supply at the head, the storage charges on the zamindars would probably fall to Rs. 8,000 or Rs. 10,000. We don't charge the zamindar anything, and don't propose to charge him. But he pays for default if he fails to do his share of the work.

92. Q. Where will you get the money from to meet the cost of the weir?—By immediate increase of cultivation, about 57 per cent. of the land sown at present fails to mature.

93. Q. Somebody will have to advance the money?—Government will find the money for the weir and recoup itself by increased cultivation, which will all be direct profit.

94. Q. What is the area of the Pakka circle?—The left bank is 318,963 acres, cultivation is 99,879 acres.

Captain
Crosthwaite.
28 Oct. 01.

WITNESS No. 4.—HAJI KALANDAR KHAN, Landowner, Daman, Dera Ismail Khan.

Witness was examined by Mr. Ibbotson, and said that he owns 5,000 acres in the Dera Ismail Khan district. He explained the advantages that would be derived from splitting up the Gomul torrent into three channels and arranging for its proper distribution, and the benefit that would accrue to Government and the cultivators by the extension of cultivation. Moreover, the diminution of water due to the extension of cultivation in the upper part

of the valley would be counterbalanced by improvements resulting if a weir were built on the Gomul. Government help was required to make the weir, but they wanted no help in managing the irrigation, except that the Deputy Commissioner should insist upon each village supplying its proper quota of labour. They don't want an Engineer officer. If they had a Revenue officer for three months in the year (July, August, and September), he would be of great help.

Haji
Kalandar
Khan.
28 Oct. 01.

WITNESS No. 5.—MAJOR H. E. S. ABBOTT, Superintending Engineer, 1st Circle, Public Works Department, Buildings and Roads Branch, Punjab.

Memorandum by Witness.

According to instructions of Chief Engineer, the points upon which I have to note are:—

(a) Character and utility of the Public Relief Works undertaken in the late famine.

(b) Works which should be completed and maintained.

(c) Works which should be classed as of little or no permanent value.

(d) Character and utility of existing programmes of work and the machinery for revising them.

Information under the above heads to be supplied separately for each district.

I have already supplied the information to Chief Engineer in the shape of reports, letters, and copies of correspondence, and will transcribe a précis of it here:—

JHELUM DISTRICT.

(a).—(i) Jhelum Canal was dug as far as Bhaluwal. A work of great utility. Requires completing. Information can best be got from Irrigation Branch, who have worked out a complete project.

(ii) Some roads in the Pind Dadan Khan Tahsil were raised on embankment. Utility questionable.

(iii) Tank at Sohawa on the Grand Trunk Road. Useful work.

(b).—(i) The above Jhelum Inundation Canal should be completed and maintained.

(ii) As regards the raised roads above mentioned, it is not much use doing such work unless it can be maintained. Still I doubt if money will be forthcoming.

(iii) The Sohawa tank was completed. Nothing more need be done.

(c).—The raised roads above referred to may, I think, be classed as works of little permanent value.

(d).—The programme provides works for as many labourers as are likely to require relief, i.e., 45,336 people for six months. The works, however, include the raising of a large number of unmetalled roads not very suitable for famine relief labour, and of much utility otherwise. Other works should be looked for. The extension of the Jhelum Canal is not yet on the programme. It should be put on. In this district programmes are, according to the Famine Code, required only for the Chakwal and Thalwag Tahsils; but the programme prepared provides works in the Jhelum Tahsil also. The people of Jhelum Tahsil would not, it is said, hesitate to go into the other tahsil areas in search of work.

Major
Abbott.
28 Oct. 01.

RAWALPINDI DISTRICT.

(a), (b), (c).—There were no relief works carried out in this district during the late famine.

(d).—Programme framed for the needs of Pindigheb Tahsil only. Provision made for 6,575 people for six months. The programme consists mainly of unmetalled roads of doubtful utility. Does not seem satisfactory. More village tanks might, I think, be dug. From what Deputy Commissioner says the making of large tanks by damming water-courses is not possible; however, no Engineers have as yet enquired into these possibilities.

SHANPUR DISTRICT.

No programme is, according to Famine Code, required for this district, and the construction of the Jhelum Canal has afforded additional security. There is, however, mention made in Government of India Resolution No. 3-01-1, of 18th March 1901, of the possible utilization of hill streams

Major Abbott.
28.Oct. 01. for the formation of storage reservoirs. Enquiries made point to unlikelihood of success attending any attempts in this direction. Water could only be impounded at uselessly great distances from spots where it was required, and it would be impregnated with salt.

HAZARA DISTRICT.

(a), (b), (c).—There were no relief works carried out in the district during the late famine.

(d).—The present programme consists entirely of works for the improvement and re-alignment of roads. Executive Engineer and also Commissioner think that it would be better to put in some works for water storage and conducting of water to irrigation. Deputy Commissioner does not think these should take precedence of road works as arranged for in the programme. All agree that the matter wants, and is worthy of, a special investigation by specially deputed Engineer and Civil Officers. Neither Public Works Department nor Civil Department has as yet been able to spare a man to look into the matter. Besides this, no plans and estimates for the works already in the programme have as yet been properly worked out, owing to paucity of establishment in this district.

DERA ISMAIL KHAN DISTRICT.

(a), (b), (c).—There were no relief works carried out in this district during the late famine.

(d).—The Daman and Thal tracts only to be provided for according to Famine Code.

From recent enquiries it appears that there are only two more works which might with advantage be added to the programme:—

(i) The construction of a protective earthwork bund to prevent damage to Dera Ismail Khan City such as was caused by the floods of last May.

(ii) Raising the frontier road from Mullazai to Vehoa.

Both of these would give considerable scope for the employment of unskilled labour. Further investigation by Engineers, and estimates and plans yet to be done. Otherwise the programme seems complete and suitable; and estimates ready.

1. Q. (*The President*).—You are Superintendent Engineer let Circle?—Yes.

2. Q. How long have you held that post?—About one year.

3. Q. Can you give us any information about famine relief works, especially as regards the provision for a future famine?—In the circle which I am in, there are very few works. I have been chiefly engaged in military engineering. I was in Simla for 4 or 5 years.

4. Q. What comprises the first circle?—Chiefly the Frontier Districts, Rawal Pindi, Jhelum, and Shahpur.

5. Q. The new arrangements which are being made for the formation of a Frontier Province will totally change your sphere of work?—Quite so.

6. Q. Have you found in those districts of which you are at present in charge a list of works capable of being included in relief works?—My information is rather imperfect, that is to say, I have not had any experience of works of this kind. Programmes have not been looked into sufficiently. Lists are not prepared by Engineers; the Civil officers point out what works are likely to be given, and the Engineers are supposed to get out estimates, plans, etc., but our establishment is so restricted we have not been able to do it properly.

7. Q. If another famine came on, do you think you would have too many works on hand?—I think not.

8. Q. I see it is only in certain portions of districts that these are intended to be kept up?—The Famine Code lays down what districts are insecure, and there we have to make provision. The programme of the Rawal Pindi district shows a number of roads of doubtful utility on which famine labour could be employed; the labour would be always on the move.

9. Q. Moving about must be very inconvenient to the people and those who are feeding them?—So I should think.

10. Q. In your circle it is only in a few tahsils that the Famine Code requires a programme of works?—Jhelum is the most insecure; they have a good many projects ready, including roads of doubtful utility.

BANNU DISTRICT.

(a), (b), (c).—There were no relief works carried out in this district during the late famine.

(d).—The Marwat tract only has to be provided for. The Local Executive Engineer says he has not had time as yet to visit all the localities at which famine relief works may have to be carried out, nor to scrutinize the projects; but from enquiries recently made and consultations with Civil authorities he is of opinion that the programme is fairly complete. It would be well to set doubts at rest by detailing a special officer and staff to investigate.

KOHAT DISTRICT.

This is not one of the insecure districts named in the Famine Code so no programme of works has been framed, and no relief works were undertaken during the late famine. The Deputy Commissioner, however, mentions 24 tanks, small works, which might be dug as relief works. Also a canal, "Bazni Channel". No details of its scope, nor any plans or description. He also mentions four other works:—

(i) "Draining of the Merobak margin," a water-logged tract three miles from Hangu, to, perhaps, give water to other lands lying east of the swamp.

(ii) The re-construction of a bund at Banda Fattah Khan near Kohat. The bund was damaged some years ago, and has not been repaired since. A considerable area known as the Bandiza lands is irrigated by its medium, the value of which would be much enhanced were the bund repaired.

(iii) The introduction of permanent "Mirabi" arrangements into the Kbattak and Barak ilaqs.

(iv) Irrigation of lands lying in the vicinity of the Dik Bungalow at Banda Daad Shah. This probably would be made practicable by the construction of a bund.

The above schemes all want proper investigation by Engineers and Revenue Officers. The local staff have not as yet had time to do this, and I doubt if it ever will be done unless some officers are specially told off to the duty.

11. Q. Have you projects ready of which you yourself approve?—Yes; but I have not seen the district, and I think that the information I could give would not be of much use. I have never had leisure to go about these districts.

12. Q. (*Mr. Higham*).—How much of the Jalapur Canal is completed?—(Described on map.)

13. Q. We have just been hearing about inundation and bunds, but I think there is no mention of this in your memo. The Deputy Commissioner never mentioned these works to me or apparently to any Engineer. This is the first I have heard of them.

14. Q. Do you know anything about village tanks?—No, except that the idea is to dig tanks on drainage lines to collect water; they are about 200 × 200 × 10 feet deep.

15. Q. How are they filled?—By rain.

16. Q. Who suggested these tanks?—The Deputy Commissioner pointed out where the tanks would be necessary.

17. Q. There is nothing about tanks in his letter?—Apparently he could not suggest anything but what was already in the programme.

18. Q. How long have these been in the programme?—The programme was sent up in April. Captain Crosthwaite has most information.

19. Q. The Government famine programme for the Jhelum and Rawal Pindi districts include tanks, I think?—Yes.

20. Q. (*Mr. Wilson*).—These projects have not yet been examined by a skilled engineer?—They have been examined by my predecessors, and those that have been examined are, no doubt, all right. There are lots of schemes talked about.

21. Q. Has anything been done to prepare estimates?—No; the orders are, we are to do it with the existing staff, and this staff has so far been insufficient.

22. Q. Do you require large additions to the staff?—No; one man and a surveyor or two.

23. Q. It is a matter of very small increase to the staff?—Yes.

24. Q. In your circle there is not very much famine?—No; only in the Jhelum district and two or three tahsils of that district. The last famine was a pretty severe one, and there was no occasion to start any famine works except in Jhelum and Pindi.

25. Q. (Mr. Ibbetson).—Had you anything to do with the drawing up of those programmes?—No.

26. Q. You have had recent experience of two severe famines; you ought to be able to say what are the maximum requirements in any district, that is, the maximum number you may have to provide work for. How many thousands can be provided with six months' work, and how

does the number compare with the maximum which will be required in the event of famine?—We engineers don't trouble ourselves about that. The Revenue authorities settle it.

27. Q. Where is the record of the Revenue Authorities?—I don't know if it is not in the Famine Code.

28. Q. Among the ordinary works proposed to be carried out there must be some which are suitable for famine labour. Are these included in the programmes?—Yes.

29. Q. A large number of the tanks are merely for drinking and washing?—Yes, village tanks.

Major
Abbott.

28 Oct. 01.

WITNESS No. 6.—MR. F. G. MUNNAY, Superintending Engineer, 3rd Circle, Public Works Department, Buildings and Roads Branch, Punjab.

1. Q. (The President).—You are Superintending Engineer, 3rd Circle?—Yes.

2. Q. How long have you been in the Circle?—About 15 months.

3. Q. Have you had any famine experience during that time?—No.

4. Q. Before that were you on famine work?—Never.

5. Q. Were there any famine relief works in your district?—In the last famine there was one, the Annhi Canal. I have given a note on that and about works which should be completed.

6. Q. Is it an inundation canal?—Yes.

7. Q. Very much of this was done during the famine?—Yes, it was one of the incomplete works. The rains came late and damaged what had been done, but there was a lot of water before the rains came.

8. Q. It has done good service?—Yes; if the canal had not been made, they would probably have had to give remission of revenue of about Rs. 5,000.

9. Q. The District Board worked it?—Yes. It was entirely made by the District Board.

10. Q. It was not a Government work at all?—No.

11. Q. It is the only relief work you had in your district?—Yes.

12. Q. (Mr. Ibbetson).—Was it properly constructed?—Yes; it was done by our Branch. They opened it before the head was completed, and the head was damaged because it had been opened too soon.

13. Q. (Mr. Higham).—When was the Annhi Canal carried out?—It was excavated in 1899.

14. Q. Before the late rains of that year?—Yes, in 1899.

15. Q. It was only open for a few days?—Yes; then the late rains occurred about August.

16. Q. And the levels were wrong?—No; I think that they were all right as far as they went. The levels were done before I took over. It was flooded suddenly in the late rains.

17. Q. Has it been running all this year?—I don't know; running some part of the year.

18. Q. Did you make village tanks?—No; I had nothing to do with the famine. I had no famine work at all.

19. Q. How has this programme been made out?—By the Executive Engineer in consultation with the Deputy Commissioner. There was too much writing about it, and I suggested there should be a meeting. Some projects are purely irrigation ones, and they are got up by the Irrigation Branch.

20. Q. How do you work out these figures?—Take out the number of cubic feet that an average man can do, omitting work that requires skilled labour.

21. Q. Have you ever worked out any proposals for storing water in the Submontane districts?—We have one worked out roughly. By damming up nine mountain torrents, we get a reservoir for holding 15 million cubic feet of water.

22. Q. That is only for cattle?—Yes; you could not irrigate from it.

23. Q. Are there no wells in that part?—No; it is on the slope of the hills.

24. Q. (Mr. Wilson).—Is there much to be done as regards detailed estimates for these suggested relief works?—We have some done. I have some more; the Irrigation Department are preparing estimates and getting out the surveys besides those included in the printed letter.

25. Q. Have you any special staff?—No.

26. Q. What special staff do you require to prepare the necessary detailed estimates for the next two years?—One Executive Engineer and a small staff.

Mr.
Murray.

28 Oct. 01.

WITNESS No. 7.—MALIK KHUDA BAKSH KHAN, Extra Assistant Commissioner, owner of a private canal in the Shahpur District.

Translation of his note, dated 24th October 1901.

So far as I know, private canals have hitherto been constructed in the Shahpur and Mooltan districts only. Those in the Shahpur district seem to have been dug before 1870, and no appreciable improvement has occurred in them since. There is no doubt that some of the private canals are capable of extension and improvement, as from previous long experience the proprietors can now find out the lands to which irrigation can be extended and what steps are necessary to secure this end. The Shahpur canals cannot easily be improved and extended, because the neighbouring lands receive irrigation from other canals, and in no direction is there any land available for its extension. Similarly there is very little hope of new canals being excavated, seeing that canals have already been cut from all possible points. There is hardly now any spot in the Shahpur district from which such a canal could be cut as would irrigate a reasonably large area. All the land which needed irrigation has already come within the irrigation limits of private and Government canals, which were in existence before the Jhelum Canal. The remaining land, called Bar, will now receive irrigation from the Jhelum Canal, that is, the entire area of the Shahpur and Bhoru tahsils, which is neither *sailab* nor *chahi*, will be irrigated by it. As regards the Khushab tahsil, part of it is mountainous and most of it is sand and *thal*, and these tracts

cannot possibly be irrigated from the Jhelum Canal. Of course part of the Khushab tahsil could be irrigated from the Government canal, which, it is said, is proposed to be cut from some point near Kalabagh. I am, however, of opinion that there are some two places near Pind Dadon Khan in the Jhelum district from which small private inundation canals could be cut. I think no new private canal has been constructed during the past ten years, and the cause probably seems to be that people were under the impression that either it was very difficult to obtain Government sanction in the matter, or no new canal could be dug without Government sanction.

As regards private canals in the Shahpur district, they were mostly constructed by individual owners for their tenants and those persons whose lands were situated near those canals. The same is probably the case in Mooltan. I have already stated that these canals were constructed between 1860 and 1870 at the instance of the authorities, at a time when no such canal probably existed in the Punjab, and the areas to which they were brought were lying waste, either as Government *razak* or private *shamilat*. A reference to the records of the last and the present settlements will clearly show the amount of waste broken up since the construction of each of these private canals, and the improvement that has taken place in the condition of persons whose

Malik
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lands have received irrigation. Although I am not in a position to say with any amount of certainty whether the owners constructed these canals simply for their own tenants, or whether they from the beginning wanted to extend irrigation to neighbouring villages, yet it is an admitted fact that at the request of neighbouring villages the owners of the canals improved them in a manner so as to carry water-supply sufficient to meet their own requirements as well as those of the neighbouring villages. In fact, I know that those villages which have hitherto received irrigation from private canals have never had any disputes on the score of insufficient water-supply, nor is there any fear of such disputes occurring in the future. On the contrary, most cordial relations have existed between the owners of the canals and the owners of the lands. So far as I know, a canal known by the name of Midh was constructed by a proprietary body in the Shahpur district, but owing to want of good management it did not prove beneficial to an appreciable extent.

The owners of the canals have for a long time been willingly allowing water from their private canals to those whose lands are situated in the neighbourhood of, and within easy reach of, any of these canals. Moreover, if any other area happens to be lying unirrigated, the owner of the canal allows water to such land at the request of the land-owners; and in lieu thereof the owner of the canal takes $\frac{1}{4}$ th share by *batai*, i.e., out of the total produce $\frac{1}{4}$ th is taken by the owner of the land, $\frac{1}{4}$ th by the owner of canal, and $\frac{1}{2}$ by the tenant.

4. The well-to-do land-owners generally wish to extend the existing canals, or to be permitted or helped by Government to construct new private canals; but, as already stated, it is difficult to get waste land to be taken up by a new canal, or to find a point from which a canal could be cut. Of course, some of the existing canals are capable of being

extended to small areas. I may also state that private canals could be most usefully extended to those areas which the large Government canals may fail to reach, and the result will be that no land will be left uncommanded by canals, and Government will not be put to the trouble of digging canals for small areas. The Government canals can prove as beneficial as large and perennial canals, such as Chenab Canal, Jhelum Canal, etc. If well-to-do land-owners and gentlemen be permitted to construct small foundation canals, they will manage them well, considering them as their means of livelihood, with the result that there will be a general increase both in the cultivated area and Government demand. Moreover, the tracts which will come within the influence of the canals will enjoy immunity from famines. Now the question is how Government should help in the extension of existing, and the construction of new, canals.

5. As regards the extension of existing canals, I am of opinion that, if the owners of canals were given slight encouragement, they would in all probability try their best to extend irrigation to those waste lands which are situated in the neighbourhood of their canals.

6. As regards the construction of new canals, it is in the first place nice to find a spot from which a canal could be cut. If such point could be found, and the land to be taken up by the new canal were to be acquired under the Land Acquisition Act for well-to-do land-owners, the new canals could be easily dug. In order to maintain the existing canals in proper order, it is for Government to render some help. For instance, if the head of a canal gets filled up, or the river changes its course, the owners of lands should not be allowed to offer any obstruction to the owner of the canal constructing a new head, and the former should be allowed a reasonable amount of compensation for the land taken up by the canal in consequence of the construction of the new head.

In reply to Mr. Robertson, witness stated: I own one canal and half of another in the Shahpur district, both of which draw their water from the river Jhelum. They irrigate about 3,500 or 4,000 acres, of which about half is my own land. From outsiders we take one-fourth of the produce of the field irrigated as the price of the water. There are no quarrels and no difficulty about collection. The irrigation has been going on since 1865. I get the clearance done and find no difficulty. We keep no separate account of canal revenue and expenditure. It is lumped up with that of the estate. I should be glad to make more canals of the same kind if there was land to be irrigated. Where there is a very large area to be irrigated, the canal

should be made by Government, but no need of this for small areas. It is bad to have too many managers. One is best or at most two. If there are 7 or 8 owners, quarrels are certain. One man might work a canal well enough, even if he had an land of his own. When we first heard of the proposed Jhelum Canal, we feared that it would interfere with our supply, but now we understand that it will not interfere with the flood supply, which is all that our canals take. So long as our supply is kept up, our cultivators will not leave for the perennial canal. When canal water has to be supplemented by a well, we take a smaller share of the produce.

SECOND DAY.

Lahore, 29th October 1901.

Witness No. 8.—Mr. W. R. H. MERR, C.S.I., Commissioner and Superintendent, Derajat Division.

Memorandum on Irrigation.

Owing to the short time allotted, I am unable to obtain exact figures, and this memorandum is necessarily in general terms only. It relates exclusively to such irrigation as is not Provincial or Imperial.

2. A glance at the rainfall returns will show that, except a portion of the Hazara district, perennial cultivation in the six frontier districts must depend entirely upon irrigation. From time immemorial the people have practised irrigation, which the Afghan immigrants (with their natural aptitude for irrigation works derived from the necessities of their own sterile and rainless country) have considerably developed during the course of several centuries. Up to date we have come to the aid of the people only in the Peshawar and Dera Ghazi Khan districts. But on the whole, even there in great measure and altogether in the other districts, irrigation matters have been left to their rude and primitive conditions. This did well enough for the first 30 or 40 years of our rule, but of late the rise in prices, the pressure of population, and the improved means of communication, have so raised the value of land and of produce that a reform and expansion of the popular system is urgently required. And as the backbone of all cultivation trans-

Indus is irrigation, the question is obviously one of vital consequence to the prosperity, development, and content of the people.

3. In Hazara, Peshawar, Kohat, and Dera G. irrigation is principally obtained from rivers and perennial streams. In Dera Ismail Khan and Dera Ghazi Khan (the canals from the Indus made by us in Dera Ghazi Khan excepted) the source of the water-supply differs altogether in character from that of the northern districts. Here it is more or less intermittent hill streams or torrents, fed by rains in the high ranges of the Mahaud country, the Takht-Suleiman, and the western Baluch high lands, that irrigate the country. The water, tearing down to the Indus, is caught and diverted by dams and weirs of intermittent stability. The beds of the torrents constantly change their alignments. In Dera Ghazi Khan wells supplement to a great extent the hill torrent supply.

4. No uniform, intelligent, and persistent system for regaining and developing this district irrigation, upon which depends the life of the people, has as yet been adopted. No doubt, the omission is due to the fact that till of late

years the popular systems worked well enough, left alone. If a deputy Commissioner took an interest in irrigation, much was done; for instance, in Dera Ismail Khan, Major Macaulay's arrangements must have added 30 per cent. to the area irrigated from hill torrents, and must have reaped more secure what was already irrigated. In Bannu Major Johnstone and Mr. Beckett did much. In Peshawar, when Deputy Commissioner, it was my good fortune to discover the traces of an old Moghul canal: my proposal to make a canal on its line was enthusiastically taken up by Mr. Sidney Preston, then Executive Engineer on the Swat Canal, and the result is the Kabul River Canal, which pays 21 per cent and has added 20,000 acres (if I write correctly from memory) to the secure and permanently irrigated area of the Peshawar district. At the present moment a project of the late Mr. Gee, Deputy Commissioner of Dera Ismail Khan, to irrigate 84,000 or 84,000 acres, as the case may be, by means of a new canal from the Indus, is before Government. All this shows what can be done. But as everything connected with district irrigation depends upon the character of the Deputy Commissioner of the time being—some men have a capacity and turn for irrigation work, others have not—what is done is necessarily spasmodic and neither continuous nor upon a comprehensive and scientific basis.

5. From what I know of frontier popular irrigation, I am convinced that the irrigating capacity, the work of the existing sources of water-supply, might be doubled by improvements in the present methods and channels and by the construction of new channels and canals. There can be no doubt about that. By improvements in existing methods I mean not only re-alignments of present water-conduits, re-adjustments of heads, amalgamations of several small channels into one large one (an obvious saving in maintenance charges), but also measures for controlling and regulating the impetuous hill torrents of Dera Ismail Khan and Dera Ghazi Khan, and for amalgamating the many troublesome inundation canals of Dera Ghazi Khan into one great perennial canal to take off (speaking under correction) just below the Tanna torrent and to end below Mithankot, a distance of 161 miles.

6. The next point is that, except in the Peshawar district, where the Peshawar Minor Canals Regulation (which I had the privilege to initiate) has brought some law or order into chaos; irrigation rights and obligations are in a condition of wild chaos, utter confusion, and uncertainty. No one knows what is the law, what is not, what are the powers of the Deputy Commissioner, what are the rights and liabilities of right-holders in water, of owners of the soil liable to canal easements, etc., etc. The Village Administration Papers sometimes record customs with more or less, generally less, precision and fullness. In the good old days, when land was not so valuable, the population less,

and the means for sending produce to markets (I mean Karachi) did not exist, this did not matter much. The Deputy Commissioner administered such customs as he found recorded, and where there was no record or, as is often the case, the records were defective or in conflict, he evolved a custom out of his own head, and everybody was content with the hukm-i-hukim. But now those days are over. A fortnight ago I was in anxious consultation with the Deputy Commissioner of Bannu over a village canal project which is capable of irrigating some 3,000 acres: it is proposed by two sets of private individuals, who of course are at feud with each other. Such recorded customs as there are give power to the Deputy Commissioner and Commissioner, but a decision of the Chief Court on a side issue connected with this very project has annulled this power, and so far as I can judge, we are helpless. Obviously the Civil Courts with their delays and interminable appeals are not the proper organs for the regulation and control of irrigation matters. The consequence in this particular instance is that the Deputy Commissioner and I decided to leave the matter alone till the local officers have legal executive powers in irrigation, and 3,000 acres must go without water for the present. The Financial Commissioner is aware that a Minor Canal Law for the Derajat is under consideration on a smaller scale, but in the aggregate to a formidable extent, difficulties of which the above is an instance, are all over the frontier hampering and strangling private enterprise and thereby retarding the development of the country. In Hazara, of which I am aware, and in Kohat, where means for irrigation are scanty, this does not matter so much; nor even in Dera Ghazi Khan, where there can be no difficulties in connection with wells and with irrigation from our canals, and where the difficulties are confined to hill torrent irrigation. But in Dera Ismail Khan (trans-Indus) and in Bannu the existing confusion and uncertainty are grave evils, and to some extent they are still so in Peshawar.

7. The conclusions which I form are—

- (1) It is imperative to develop, reform, and add to the existing district irrigation trans-Indus.
- (2) Rights and obligations, the law, relating to such irrigation should be codified and enacted so that, to put it colloquially, the people and their officers know where they are.
- (3) To effect (1) and (2), it is necessary to employ professional agency under the orders of the head of the Civil Administration, and working in intimate relations with the District Officers on popular lines.
- (4) The formation of a Frontier Province presents a capital opportunity for the purposes of (1), (2), and (3).

1. Q. (*The President*.)—For how many years, Mr. Merk, have you been in the Derajat?—Nearly two years.

2. Q. Did you have experience of the frontier before that?—All my service, off and on, has been on the frontier.

3. Q. As regards the rainfall, I understand there is nothing corresponding to the monsoon on the frontier?—Nothing at all; in the Hazara district and from the western portion of Peshawar to Dera Ghazi Khan you get occasional showers at the time of the monsoon; you get the tail of it at Peshawar, but there are no regular rains.

4. Q. What is the rainfall?—It varies from district to district; there may be nothing at all for nearly a year, and again there may be 14 inches in one day.

5. Q. There is nothing, I suppose, to depend upon?—No, nothing; in nine years out of ten there may be heavy rains in the mountainous country to the west, into which storms sweep up from the flat country below.

6. Q. When do you have the winter rains?—Generally about the middle of January or February; they are fairly heavy, sometimes lasting for two days at a time.

7. Q. Is not this too late from an agricultural point of view?—No.

8. Q. When is the harvest?—The spring harvest is in April and May.

9. Q. You allude in your memorandum to the Kabul River Canal; is that finished?—Yes, it was finished in 1892. It was broken by very heavy rains that year; that was the year we had 14 inches of rain in 24 hours—it is a thing that happens once in ten or twelve years. The canal was reconstructed in 1893, and has since then been running without interruption; it is on the line of an old Moghul Canal, the

traces of which gave me the idea, and Mr. Preston and I worked it out.

10. Q. What is the discharge of the canal?—I do not know. (Mr. Higham explained that the discharge is 224 cusecs.)

11. Q. Is the canal a productive work?—Yes, it pays 21 per cent., and it will eventually pay 25 per cent. It was our good luck to take it through a densely populated country where water is of great consequence to the people and where there are skilled labourers.

12. Q. The Swat River Canal is worked as an Imperial work?—Yes, entirely; that also is on the line of an old Buddhist Canal.

13. Q. You allude in your memorandum to a project relating to a proposal for irrigating 84,000 acres in Dera Ismail Khan?—Yes. (Explained on a map). The canal would be perennial.

14. Q. We had evidence yesterday in which allusion was made to the Pabarpur project?—That is the canal I refer to. You can make it perennial.

15. Q. For that you will probably want a weir?—Not if you take it off at the rocky head. (Explained on map)

16. Q. You refer in your memorandum to great trouble as regards water-rights and so on; is the Swat River Canal administered in the same way as the Kabul River Canal?—No, it is managed under the Canal Act.

17. Q. Could you not introduce a similar regulation here or at Dera Ismail Khan?—It would be necessary to embody the local customs and rights, which are quite different from ours.

Mr. Merk.

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Mr. Merh. 18. Q. You have done this on the Kabul River Canal?—We make our conditions as we please on our property; we give water to whom we like, but the district canals are the property of the people; the Kabul River Canal we govern ourselves.

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19. Q. We had some talk yesterday about a big dam that was wanted on the Gomul?—Yes, that is an instance of where we wanted scientific assistance. (Witness explained by reference to a rough sketch that the work is now done in an unscientific manner, and the way in which it was proposed to rectify matters.)

20. Q. Do the people accept these proposals?—Yes, there had been so much trouble and difficulty that they say—"anything for peace." In Bannu you get the Kurram river which carries an immense flood; there you should have a similar weir, but we want professional help. What is wanted is to amalgamate a number of the small private canals.

21. Q. Would the agriculturists accept that proposal?—Yes, once they understand it; as long as we guarantee that we will not interfere with their rights.

22. Q. Do they not look upon every interference of that sort as to their disadvantage?—No, not so long as we explain that the revenue is not to be enhanced. If they come to understand that the idea is simply to make things work distributing water better, they will agree.

23. Q. At present they pay water-rates?—Not a separate water-rate, but a consolidated land revenue; this is a simple method; we do not require to maintain an establishment for assessing a water-rate; we take the whole as wet land revenue.

24. Q. (Mr. Jebelton.)—Who does?—Government does. In Dera Ismail Khan a bund is wanted, but we want professional assistance; our own people can only tell us what to do, not how to do it.

25. Q. (The President.)—Is there any likelihood of professional scientific work being done without upsetting the local customs?—Yes, when the people understand it is to their benefit, they are quite prepared to do it. On the Kabul river there was great interference, but as soon as the people grasped the position, there was no difficulty.

26. Q. If you had a big canal as Mr. Geo proposed, would you have the administration worked just like the Bari Doab Canal?—Yes; it would be too big to be worked by the Civil authorities.

27. Q. If a large canal were to take the place of native water-courses, the question of existing rights would come in?—These we would conserve; in the Pliorpur canal there is very little irrigation that would be affected; and the same is the case in Dera Ghazi Khan; there are very few vested rights. There is one thing, however, to be considered; in consequence of the peace which we have established in the hills, the supply of water from the hill torrents is diminishing steadily; since the establishment of our rule in Tochi, the water has been diverted and the cultivation has increased there 15 to 20 per cent; consequently the water-supply of Bannu has decreased.

28. Q. Yesterday we were told that, if the Ratti Kumar bund were constructed on the Luni, it would not matter how much water was taken above?—That is a professional question about which I could not give an opinion.

29. Q. Is there any possibility of constructing tanks?—Only very small tanks; you could not make big tanks; the great thing in Dera Ismail Khan and Dera Ghazi Khan is to regulate the course of the torrents, and to dam up the streams. If we could get professional assistance about that and regulate the course of the torrents, it would be of great assistance; at present we have to go by the light of nature and by what the natives tell us.

30. Q. At Dera Ghazi Khan would you require a dam over the Indus?—No, I don't think so.

31. Q. Looking upon it not from a professional point of view, but from the ordinary administrative point of view, how would you compare the conditions of canals in Dera Ismail Khan and Dera Ghazi Khan west of the Indus with the Sind Sagar project on the other side. If you had, for instance, to give a grant, how would you divide it?—Well, I look upon it to a certain extent with the eyes of a man who has bother on his hands. It is a great thing to have good irrigation close to the hills; it is a great pacifier; it would be better to spend the money on irrigation works than on an expedition.

32. Q. Would you say, other things being equal, that there are sufficient State reasons for preferring a canal west of the Indus?—Yes, strong political reasons. After the Swat Canal was finished, half the Mohmand tribe settled in British territory on the Swat Canal lands, and with the establishment of peace that process will continue. If you improve the means of irrigation and have a clear law, if you make it more a business matter in fact, this will be brought about.

33. Q. It is not a country where you have to dread famine?—No, on account of the character of the people—they are enterprising—and if famine threatens, they break up their homes and leave.

34. Q. Does it threaten?—It is a case of perennial famines in the unirrigated tracts; *kharif* crops have failed this year; once in ten years the autumn or spring crop is a bumper one and the people live on that for ten years. You find them leave their homes and go elsewhere. I have found Peshawaris in Dera Ismail Khan breaking stones; there are hundreds and thousands in the Punjab and even as far as Bengal and Calcutta.

35. Q. Of course, we are concerned chiefly with questions of famine protection and famine relief. I gather that in the country you have been describing famine relief does not come in and famine protection not to any great extent. In that case, as regards the food-supply of the country and apart from political questions, it does not matter whether an area of 100,000 acres is added on this or that side of the Indus?—No; there was famine in Hazara in 1878. During the recent famine in the Punjab there was great scarcity, altogether prices went up to a higher extent than there, but it was nothing like famine.

36. Q. The inundation canals, I understand, are of double use in irrigating the *kharif* crop and starting the *rabi*?—Yes, and also irrigating *rabi*.

37. Q. When do they generally dry up?—A great many of them are perennial; the small canals of the people are perennial.

38. Q. Are these private?—Yes, made by the predecessors of the present owners; made by the people and kept up by the people; they are probably a thousand years old.

39. Q. They must be very deep?—The river is spread out and then there are floods which help them along. From the Kabul river there is a perennial supply in Peshawar; in Tochi and in Kurram there are perennial streams, but not below, and that is where the difficulty comes in.

40. Q. Can private canals be worked at all satisfactorily?—Yes, if the law is clear, they can.

41. Q. The evidence we had yesterday was very much to the effect that the sooner private canals were controlled by the Deputy Commissioner the better—the cases of Hoshim-pur and Montgomery were quoted?—Those are isolated canals, but this is a network of perhaps 600 canals in one district like Peshawar; there the Deputy Commissioner could never work; he only steps in to settle disputes; the ordinary management is left entirely to the people.

42. Q.—I suppose there are a number of shareholders in each canal?—Yes, and the whole thing is worked out in detail down to the rights of each man, which are recorded; it is worked out by the people themselves, and we only step in when there are disputes about water-rights, etc.

43. Q. Is this management one that gives satisfaction to the people?—Yes, it is management by the people, and has been recorded in Peshawar with great care in the settlements.

44. Q. Have you had any experience of inundation canals away from the frontier?—No.

45. Q. Is there much well irrigation?—There is some in Dera Ghazi Khan; not much in Dera Ismail Khan, and a certain amount in Peshawar; the Persian wheel is employed.

46. Q. Are wells put down to carry on the work begun by inundation canals in the Punjab?—No.

47. Q. Are they *pakka* wells?—They are lined with masonry in Dera Ghazi Khan.

48. Q. What is the cost?—That depends on the distance of the water from the surface. It may be anything from 4 to 25 feet.

49. Q. Wells are not very expensive, are they?—Certainly not more than Rs. 1,000. A well lined with brick would never run to more than Rs. 1,000.

50. Q. Are the people glad to take *takavi*?—Yes.

61. Q. Do you think the system of *takari* can be made more easy and popular?—Yes; there are great delays now.

62. Q.—What do you think of the rate of interest?—I don't think it is too much.

63. Q. It is 6½ per cent.?—Yes, it is better than they can get from the *bania*.

64. Q. If they could get 8 per cent., you don't think that would increase the number of wells?—No, I don't think so. I once had applications for 1½ lakhs of *takari* in camp at Peshawar; they put in their applications, and the cases were decided on the spot, but you cannot always do that. They come for *takari* if there are no delays and difficulties.

65. Q. I suppose the security is a good one. Does Government lose its money often?—Very rarely, and the well is a very valuable asset. I asked a banker, and I found that, if I gave as surety the mortgage of a house, I should be very lucky if I had not to pay 8 per cent.; for a loan even on gilt edge securities, you have to pay 10 per cent.

66. Q. (Mr. Ubbetson).—I understand the management at present is absolutely with the Deputy Commissioner?—Yes, the supervision and control.

67. Q. I understand from reading your note that you propose to substitute for that, management by the Canal Department?—No, that is not my meaning. I am sorry if you gathered that from my note. What I said was intended to refer only to construction.

68. Q. When things are in working order, you don't propose it should be made over to the Canal Department?—No, to the Deputy Commissioner, who will have the advice of professional agency.

69. Q. I see in Peshawar and Kohat you have a water-cess; instead of taking labour, you take money?—No, it is only a small portion of maintenance; practically nothing.

70. Q. You don't propose to substitute a cess?—No.

71. Q. The labour system works well?—Yes, but you want legal power to enforce it. In a canal run by the people the labour system is the best.

72. Q. Is it not the case that in this re-adjustment and reconstruction which you propose some people will lose their water altogether?—No, we never deprive a man of water; we take good care of that.

73. Q. That is a *sine qua non*?—Yes.

74. Q. You don't mean that only some few may be deprived of their water?—No, the whole countryside would be against you.

75. Q. You have no record of irrigation rights?—Yes, in Peshawar.

76. Q. There are districts in which you have no record of rights?—It was not necessary in the old days.

77. Q. That will be supplied in the next settlement?—In Dera Ismail Khan it will be supplied now and in Bannu in the next settlement in six years' time. It is no use having the record unless you have the power to enforce it.

78. Q. Suppose you have the record. At present your system is working well, and the Deputy Commissioner's authority is sufficient, though it has no legal basis; you want to legislate and then you limit the authority of the Deputy Commissioner, because you deter him from doing anything outside the four corners of your Act?—At present the Deputy Commissioner cannot do anything at all.

79. Q. He does do it?—I will give you an instance in Bannu. A leading native got permission from the Deputy Commissioner to construct a canal; afterwards he extended it, without the permission of the Deputy Commissioner, who was a different man, and was fined for doing so. Afterwards he appealed to the Chief Court, and the sentence was cancelled. What is to be done in such a case?

80. Q. You think, then, that the time has come when legislation is necessary?—Yes.

81. Q. With reference to the increase of cultivation higher up in the hills, in some places it has happened that a bund has been built and there has been a consequent diminution in the supply lower down?—In Tochi the supply will be diminished in the next ten years, but not in the Luni.

82. Q. Do I understand that on the frontier, speaking generally, land is of no use without water?—It is of great use once in five or ten years.

83. Q. You said that wells can be made at a reasonable cost without difficulty?—Only in certain places. In Dera

Ismail Khan the subsoil water is very deep; in the Trans-Indus portion there is a substratum of salt-petre, and for drinking-water people have often to go to tanks.

84. Q. I should like to know whether on the frontier there is a large area for extension of well irrigation?—In Dera Ghazi Khan there is, but there is no population; in Dera Ismail Khan there is not, because the water is deep down; that is also the case in Bannu and Kohat.

85. Q. Then it is not a question of money that is restricting well irrigation?—No.

86. Q. It is not a question of *takari*?—No, there are physical reasons; besides, there is the want of water and want of population. Artesian wells in Tank might do a great deal.

87. Q. When you have got your water brought near the land, is any local expenditure required to prepare the land for irrigation?—The people do this themselves regularly. They don't want help. On the Kabul river and Swat Canals they did it themselves.

88. Q. Was it done by the landlords or tenants?—It depends—it may be done by an occupancy tenant.

89. Q. Has he any legal protection?—Yes, he gets compensation.

90. Q. Can any money compensate a man?—If he is a tenant-at-will, of course.

91. Q. Local feeling prevents him from being turned out?—Yes, as a rule, except when the landlords are afraid of a tenant-at-will getting occupancy rights.

92. Q. Have you many cases of canal-owed by one or a few owners in which water is supplied to people who have no share?—There are a few cases; any right-holder can sell his water to anybody.

93. Q. In the construction of a well is the man fairly sure of finding water?—They use the hazel and there are, besides, professional water-finders—Ghilzais—who come down, and that answers fairly well.

94. Q. Are there physical difficulties to be encountered?—No. Trial shafts are sunk first. It costs about Rs. 10 in each case. These men are professional well-sinkers who come down, for many generations; they have done it and are very good at it.

95. Q. In some districts would it be a real help to give them any kind of assistance, such as you suggest in the matter of artesian wells?—In Tank this might be possible.

96. Q. That would be a supply of drinking-water?—Yes.

97. Q. It has been suggested that Government should construct wells and recoup itself by the imposition of a water-rate on the irrigated area?—It is quite unnecessary on the frontier; it would lead to friction; the people do it much cheaper.

98. Q. There would be difficulty in adjusting the recoupment?—Yes, if they want Government assistance, they can get *takari*.

99. Q. Do you accept ordinarily the joint security of a village for *takari* advances?—That depends on the village; if the village were united, we would; but we would not if it were not united.

100. Q. It is the experience of many parts of India that joint security may be accepted with absolute safety?—That depends on local conditions; it is better security if the people are united.

101. Q. The period for which *takari* loans are given is, it is thought, too short; although the rules admit of 20 years, in practice they are only given for 10 or 12 years, and that, it is said, is much too short; is that your experience?—I have never limited the period.

102. Q. It is, I suppose, the fault of the Deputy Commissioner if the period is limited?—Quite so. We give them 15 to 20 years. The matter is entirely in the hands of the District Officer.

103. Q. (Mr. Rajaratna).—Do you think the extension of the period to 30 years would encourage the people?—I don't think so, because they like to get rid of the liability as soon as possible. There are many business men among them, and they quite understand this.

104. Q. But in the case of a costly well, costing say Rs. 1,000?—Well, a man might take the longer term in such a case, but he may die and be succeeded by a spendthrift, and there would be difficulty in getting your money back. I have never been asked for more than 20 years.

105. Q. (The President).—The power of the Deputy Commissioner is to give the loan up to 20 years?—Yes.

Mr. Mark.

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96. Q. (Mr. Rajaratna).—We have 30 years in Madras?—You have bigger works probably.

97. Q. As regards the man who was fined by the Deputy Commissioner for extending his canal, was that done by magisterial order?—It was held by the Chief Court that the punishment was out of the power of the Deputy Commissioner.

98. Q. (The President).—On what conditions is a man allowed to construct a canal?—The custom of the land which permits him to make a canal with the permission of the Deputy Commissioner.

99. Q. Is he bound to irrigate only a certain area?—No.

100. Q. Does he pay anything to Government?—Yet land revenue, but not more than was fixed at the settlement; the area is not limited.

101. Q. Don't you limit the area?—That depends very much on the lie of the country. If he was told he could make a canal of certain dimensions, he should not irrigate more. If there is a law, you must enforce it.

102. Q. Irrigate more than what?—More than by the directions he got.

103. Q. (Mr. J. J. Erk).—I understand you to say that you think the period of exemption is sufficiently liberal?—I think so.

104. Q. How far is the tenant who makes such improvements protected from enhancements of rent?—A tenant at will would not be allowed to make a well.

105. Q. Apart from wells, small irrigation bunds, etc.?—He might do that.

106. Q. Would he be protected against enhancement of rent?—Popular custom would prevent it.

107. Q. Is there any legal protection?—No.

108. Q. (Mr. Wilson).—I understand you to say that with professional aid there would be a development of irrigation?—Yes. I can only judge from my own experience, looking at the professional aid given by the Irrigation Department in the Kabul river and Ilra.

109. Q. In the Daman what form should that assistance take?—They might tell us how to regulate the hill torrents, as is done in France and Switzerland.

110. Q. Would they take levels and so on?—The work done would be similar to that you see in the south of Europe; the streams would be regulated and trees planted to steady the current, instead of its spending all over; at present you do not know where your hill torrent will be next year. In Dera Ismail Khan and Dera Ghazi Khan very much could be done in that way by professional agency.

111. Q. At whose cost would this be carried out?—I suppose jointly at the cost of Government and the people.

112. Q. There would be an embankment at the Batti Kun or on the Luni?—Only a professional man could tell us that.

113. Q. Would it not have to be carried out at the cost of Government?—Probably people will take *takari* and pay half the cost.

114. Q. We were told that it would cost 5 lakhs of rupees. I suppose the people would not take *takari* to anything like that sum?—No.

115. Q. Then it would have to be done entirely at the cost of Government?—Yes.

116. Q. What would be the return to Government?—Increased irrigation and land revenue.

117. Q. Would you take water rates on the irrigated land?—People prefer wet land revenue.

118. Q. We were told that the whole of the assessment would be fluctuating in future and the amount of land revenue would be 2 lakhs of rupees a year. That would increase with the area irrigated?—Yes.

119. Q. Do you think this large expenditure would be financially profitable to Government?—I cannot say; that is a thing I could not give an opinion about offhand. It could be worked out what area will be added and the revenue; if the percentage comes to 3 per cent., it would pay.

120. Q. Is the District Board likely to advance the money?—It has no money.

121. Q. Where are the funds for the survey to come from—from Government?—It is worth the risk; a professional man could survey the whole of this tract. If the revenue you got from the additional area came to say 4 per cent., I should say do it.

122. Q. We were told that the reduction in the water-supply of the Gomul owing to the spread of irrigation further up affects the Kalapani?—Yes.

123. Q. If there were an embankment over down, that would not occur?—I cannot tell you. It is a professional question. I can only say there is something wanted there which requires attention. I don't know in the least what it would cost.

124. Q. Have you seen the artesian wells at Quetta?—I think a good deal might be done that way.

125. Q. Both for drinking-water and irrigation?—Yes.

126. Q. Is there no salt in those hills?—There is no rock-salt, but there are mineral springs.

127. Q. Are these artesian wells 500 feet deep?—I could not say.

128. Q. Professional skill would be required in the matter?—Yes.

129. Q. You don't think the amount of interest charged affects the amount of *takari* taken; speaking as regards the Punjab generally, if there were no interest, would there be an increased demand for *takari*?—No doubt, there would.

130. Q. No interest is better than 6½ per cent., is it not?—No doubt, but I think we are entitled to charge for the use of money. I don't think there is any claim on us to lend public money free of interest.

131. Q. (Mr. J. J. Erk).—Do you think this rate of interest opposes any obstacle to the extension of well irrigation?—No. I do not think so.

132. Q. (Mr. Wilson).—About these streams from which private canals take out, are they very different from the rivers of the Punjab? Is the fall much greater?—It is slightly greater.

133. Q. Is it not very much easier to make little cuts?—That depends on the banks; the banks in Peshawar are flush with the water.

134. Q. Do you think you could do much by improving the present system?—You could do a great deal.

135. Q. Where there is room for making new canals, would you advise that private canals should be encouraged or that Government should take up the work?—It depends upon the site.

136. Q. You say the Deputy Commissioner has not sufficient legal authority?—None whatever in Bannu and Dera Ismail Khan.

137. Q. What is your opinion of the working of the Minor Canals Act?—I don't think the Act should be applied to the frontier; we should have the regulations very elastic and capable of being altered as circumstances arise.

138. Q. (Mr. J. J. Erk).—Supposing a man wanted to build a private canal and to take it over other people's land, is there any power to do so, or can they prevent him?—There is no power under the Land Acquisition Act; in Bannu and Peshawar there is a custom that, if a man pays compensation, he can do so. The Deputy Commissioner has no power in these matters, and they should be regulated; a single man in a village may refuse to grant permission, which the rest are willing to grant, and the whole thing is blocked.

139. Q. (Mr. Higham).—On the opening of the Kabul River Canals were the men granted the rights they had had on their own canals?—Yes.

140. Q. There was no difficulty in arranging that?—No; not once they understood the scheme.

141. Q. In the case of the Bara Canal, when you introduced the regular distribution, you deprived the men who used to get more than their share?—We guaranteed to them what they were entitled to by custom; the men who took more were in the minority, and their objections carried no weight; the great bulk agreed to it; the minority will give way when they find that the majority is supported by us.

142. Q. How has this worked? Has it worked satisfactorily?—Yes, when I was in Peshawar, it worked all right; what we want is professional agency to advise in technical matters. As soon as the people see that it is to their benefit, they agree to our proposals. They are very shrewd in irrigation matters; they understand the thing; it is a question of personal confidence in the Deputy Commissioner. In Bannu there will be great difficulties at first, there will be a tremendous outcry, but after a time matters will settle down.

143. Q. The Hazari Khani branch has been under consideration for five years?—Yes, it is a question of funds.

144. Q. How do you propose to find money for these improvements? Do you depend on the Province?—Partly on

the people and partly on the Province. In the case of new canals I would depend on the Province.

145. Q. You cannot depend on the Province, because there is no money?—The frontier Province may have some money.

146. Q. Would the people take a loan?—They cannot take a large loan.

147. Q. Supposing you want two lakhs of rupees for training a torrent, if the Government advanced one half and paid the other, how would it answer?—I don't think the people would ever take more than Rs. 10,000 in *takavi*.

148. Q. Anything more than that Government must advance?—Yes, and trust to the revenue to recoup it.

149. Q. You cannot raise revenue rates at all?—No, but for your own water you can charge anything you like. Mr. Gee's canal at Bahawalpur will be our own canal, and we may charge anything we like.

150. Q. Did you charge the people on the Kabul river who had old irrigation?—No, they had water free, as much as they were entitled to; if they took more, they would have to pay for it.

151. Q. You never had relief works in Dera Ismail Khan?—No, nowhere in the frontier except in Hazara in 1878. In the hills of Dera Ghazi Khan we had relief works in the Baluch country.

152. Q. You received yesterday a programme of Dera Ismail Khan district relief works (shown to witness)?—That will never be wanted.

153. Q. You talk in your note about improvements of the canals?—Yes, these are for my part of the country and for political reasons.

154. Q. These improvements of the canals find no place in their programme?—No.

155. Q. Would it not be a good thing to employ the people generally?—These improvements employ a good deal of professional labour. They are good enough, but the relief works will never be required. Tanks are good, but they dry up again. All I have said about frontier irrigation is not with regard to famine, but to improve the area for political reasons.

156. Q. Do you think if there was a perennial canal in Dera Ismail Khan on a large scale, there would be any danger of a rise in the spring level?—No.

Mr. Merk.

29 Oct. 01.

WITNESS No. 8.—Colonel L. J. H. GREY, Superintendent, Bahawalpur State.

I.—Memorandum by Witness on Canals and Wells.

The subject on which I can give opinions are—

- (1) Co-operative district canals.
- (2) Inundation canals generally.
- (3) Construction of wells.

2. As to (1), these may, in my opinion, be dismissed from consideration. There is only one such enterprise that I know of which has succeeded and is of any importance, and for many reasons none such is ever likely to succeed again, or indeed to be attempted.

3. The Ferozepore Canals have worked successfully for many years, and they are important as having an irrigating capacity of considerably above 200,000 acres, and having actually attained that area of irrigation. Their construction is fully described in printed reports of 1875-76-77, and my painful experiences therein stated would, I imagine, deter any District Officer from attempting to imitate the operation, even were it now possible to do so. I returned to Ferozepore in 1880 to find the irrigation system in danger of collapse, but succeeded then in renewing and extending it, and I devised the existing system of maintenance before I left the district in 1882, as described in a report of that year. In 1883-84, as Commissioner of the Hissar Division, I extended the system into Fazilka, completing it as it now exists; and in 1890, as Officiating Financial Commissioner, I remodelled the system of maintenance established in 1882, as detailed in the Government Proceedings of November 1890. I have fully stated the method of construction and maintenance of such works in a manual published by Government in 1891. Since then I have no further knowledge of them, but Rai Bahadur Maya Das, who has been in charge of the canals since 1882, can give any particulars that may be required.

4. With regard to (2) of my paragraph 1, my opinion is that the days of inundation irrigation have passed. The rivers have been, or are being, tapped to a degree which much lowers the value of these works by depriving them of the early and late water which is so important to irrigators. The method was, after all, but a makeshift; it has had its day; and the time has come for arresting the summer floods by weirs, and for distributing them scientifically over the country to afford a duty of 200 acres to the cusec instead of the 30 or 40 acres which is the average of inundation canals.

On the special subject of inundation canals in the Bahawalpur State, Khan Bahadur Mirza Jind Vade Khan, the Wazir of the State, will give information better than I can.

5. As to (3) of my paragraph 1, my view is that well construction should go hand in hand with the canal irrigation which affords the springs for well irrigation. Canal water should be given so very sparingly as to drive the people to use the wells they have and to sink others. Not only would the water thus go much further, but we should hear less of water-logging and malaria. The ideal canal irrigation to my mind is that which creates and extends well irrigation, and is supplemented by the latter when river water fails.

Development of well irrigation, like any other form of district progress, depends upon the District Officer. That the District Officer should be able to achieve anything in this direction, he needs—

- (a) knowledge of his villages;
- (b) time for moving about and attending to his enterprise;
- (c) a free hand in *takavi*.

(a) of the above implies some permanence of tenure, and of course both zeal and discretion are supposed.

As regards (c), in no commercial enterprise can anything be achieved unless risk is taken. It should be accepted that the Deputy Commissioner may occasionally lose money. But on the whole what better business can there be than one which borrows at $3\frac{1}{2}$ per cent. to lend at 6 $\frac{1}{2}$, and which makes an average of Rs. 500 profit on every well constructed on these terms? I here assume that the wells will be charged from Rs. 15 to Rs. 25 *abiana*, say an average of Rs. 20 per annum, for the balance of an average well life of 40 years, after expiry of an average period of protection of 15 years:— $20 \times (40-15) = 500$. In the Bahawalpur State *takavi* is given without charge of interest. I attach a memorandum which I there issued showing the commercial advantage, even on those terms, in encouraging well cultivation by liberal loans. The well's life is therein taken as permanent, because, in fact, timely outlay on repair does extend it to an indefinite period.

During the last two years there has been a great extension of well construction on *takavi* loans in Bahawalpur, regarding which the Wazir can give particulars. This, however, is likely to suffer, as the inundation canals there are already suffering from the effect of the great works constructed, under construction, or projected, in the Punjab.

Col. Grey.

29 Oct. 01.

Note by Colonel L. J. H. Grey addressed to the Mashir Mal regarding profit on Takavi wells, dated 9th March 1900.

In continuation of my memos. of 21st February 1900, 26th February 1900, and 2nd March 1900, on the subject of *takavi*, it is well to show the actual figures of profit on lending money for wells.

2. Rupees 300 invested in Government paper yields $3\frac{1}{2}$ per cent., or in 12 years it is worth $300(1 + \frac{3\frac{1}{2}}{100})^{12} = \text{Rs. } 453.5-0$. (a)

Col Grey. If the Rs. 300 be lent on *takavi*, it is recovered in 12 years as follows:—

		Rs. A. P.	Nil.
2 years			
3rd year	$30 = 30 (1 + \frac{31}{100})^2$	= 40	14 0
4th "	$30 = 30 (1 + \frac{31}{100})^3$	= 39	8 0
5th "	$30 = 30 (1 + \frac{31}{100})^4$	= 38	3 0
6th "	$30 = 30 (1 + \frac{31}{100})^5$	= 36	11 0
7th "	$30 = 30 (1 + \frac{31}{100})^6$	= 35	10 0
8th "	$30 = 30 (1 + \frac{31}{100})^7$	= 34	7 0
9th "	$30 = 30 (1 + \frac{31}{100})^8$	= 33	4 0
10th "	$30 = 37 (1 + \frac{31}{100})^2$	= 32	2 0
11th "	$30 = 30 (1 + \frac{31}{100})^1$	= 31	1 0
12th "	$30 = 30 (1 + \frac{31}{100})^0$	= 30	0 0
Total		351	15 0 (b)

(a) minus (b) or Rs. 101-6 is therefore the actual cost of the loan to the State.

3. For this capital outlay of Rs. 101-6 the State will obtain, for ever, the charge imposed on the well after expiration of the 12 years' *Patta*, say 20 per cent. per annum, if my recommendation in paragraph 4 is adopted. There are indeed few investments which yield so large a return as 20 per cent.

4. I recommend that this charge be fixed at Rs. 20 *bilmukta* in excess of whatever the 50 *bighas* of land may be paying at the revenue rates of the village, viz., Rs. 20 should be added to the *jama* of the village, and to the *Khatavani* of the well owner, after 12 years from date of completion of the well.

II.—Note upon the Statements of Ferozepur Irrigation furnished to the Irrigation Commission by Rai Bahadar Maya Das, dated the 16th October 1901.

The co-operative irrigation works in Ferozepur appear from these statements to yield profits as follows:—

(a) to their owners a profit of above Rs. 3 per acre upon an outlay of *nil*.

(b) to Government a revenue of about 1½ lakhs of rupees upon an outlay of *nil*.

(a) May be otherwise stated, viz., that the average increase of the value of the irrigators' crops, by irrigation from the works which they own, is Rs. 5 per acre, from a capital outlay of Rs. 5-8 per acre—which outlay has, however, been recouped, with a large margin, in the conversion of 94,633 acres of unculturable and unsaleable waste into valuable arable land by deposit of silt;

(b) may be detailed as being one lakh of 'water advantage' rate on an average irrigated area of 170,000 acres, and more than half a lakh of 'dry' revenue on the above 94,633 acres of land rendered assessable by the canals, and assessed to revenue in the Settlement of 1887-90.

2. These results are derived as follows from Rai Bahadar Maya Das's statements:—The grand total of 26 years' irrigation is shown by Statement C to be 3,032,007 acres. The total capital cost by his Statement A is Rs. 9,33,249; and the total cost of silt clearance, establishment and other maintenance expenses for the 26 years is shown in Statement B as Rs. 15,83,765. The maximum irrigated area is shown by Statement C to have been attained in 1900, being 278,823 acres; and from that statement the average of the period 1896-97 to 1900-01 is 170,516 acres. Taking the future average for safety at the latter figure, the capital cost upon that average is Rs. 5-7-7 per acre. The average cost of maintenance for the same period of five years is shown in Statement B as Rs. 1,21,076, which falls on the average of irrigation for the period at annas 10-11. The initial and annual cost of the canals may therefore be taken at Rs. 5-8 per acre and annas 11 per acre respectively upon the average irrigated area.

3. The average increase of value of crops by this irrigation, in Fozilka, was estimated by Mr. James Wilson, Settlement Officer of Sirsa, at Rs. 8 per acre in a note, dated 13th January 1884. Mr. Francis Settlement Officer of Ferozepur, in a note of 23rd October 1890, estimated the value of increase in Ferozepur at Rs. 2-8 to Rs. 3 per acre, "after deducting cost of clearance and establishment together with a small allowance for the capital sunk." The similar Government inundation canals in Montgomery charge an average of Rs. 2-8 per acre for water, which is presumably estimated at half the increase of value of crops from the irrigation. On these data a safe estimate of the average increase of value of crops by the Ferozepur irrigation is Rs. 5 per acre. From this profit may be deducted Rs. 1-7-0 per acre as follows:—Average cost of maintenance shown above Rs. 0-11-0; average of 'water advantage' rate taken by Government Rs. 0-12-0; total Rs. 1-7-0. The net profit of the irrigators is therefore Rs. 3 to Rs. 4 per acre yearly; and this is upon an outlay of *nil* because the accounts made up to 1895-96 showed that, up to that year, the canals had

paid off their capital cost, and all maintenance charges to date, with a balance of sixty-seven lakhs of rupees, as follows:—

Cr.	Dr.
(1) Increment of value of 94,633 acres shown by Rai Bahadar Maya Das from the survey figures of 1897 to have been "waste unculturable land that has been silted and made into fertile and new land"	Capital outlay and cost of maintenance to 1895-96, Rs. 16,78,033
(2) Increment of value of 94,633 acres of 'dry' land converted to 'irrigated'	Govt. Rs. 17 lakhs
(3) Water rent at Rs. 2-4-0 per acre, which would have been paid had the canals been constructed by Government, on 2,28,731 acres irrigated up to 1895-96	Balance 67 "
	51 "

It results that the profit of the irrigation is really from Rs. 3 to Rs. 4 per acre on an outlay of *nil*.

4. The profit of the Government is also about 1½ lakhs on an outlay of *nil*. The Government Resolution No. 43 of the 6th August 1895 estimates the Government profit at Rs. one lakh yearly, and paragraph 5 of Rai Bahadar Maya Das's note, which accompanies his statements, states the yearly profit at that figure. But one lakh is the 'water advantage' rate only, whereas the 'dry' revenue on 94,633 acres of waste land, above shown as made arable by the canals and assessed in 1887, must be at least half a lakh more. The result is that the Ferozepur co-operative irrigation works afford to their owners a profit of some five to six lakhs per annum (170,000 acres average irrigation) at from Rs. 3 to Rs. 4 net profit per acre, and to the Government a profit of above one and a half lakhs per annum; in both cases upon an outlay of *nil*.

5. The above is the rosy side of such an undertaking. The reverse side may be seen from the following extracts of Captain Grey's printed report of 1876-77. It accounts for the lack of response to the hopes expressed in Punjab Government Resolution No. 43 of the 6th August 1886 "that the success which has been obtained in Ferozepur will encourage officers in other districts favourably situated for the construction of inundation canals to carefully consider the feasibility of the creation of such works, and to use their best efforts to induce the villagers to combine for their execution":—The Lieutenant-Governor of the Punjab passed the 15th—17th February 1876 in the Zira Tahsil of

this district. Throughout that time he was completely mobbed by zamindars of that tahsil petitioning against the continuance of the canal undertakings. Canal operations had been appointed to commence in January, and from that time till the Lieutenant-Governor's arrival frequent deputations of zamindars from all three Tahsils concerned had been to the Commissioner at Lahore to object to the canal work, and petitions had been addressed also by post to the Lieutenant-Governor. When, however, the latter was in Zira, it was only the zamindars of that tahsil who besieged his camp * * * The malcontents urged, in fact, that canals were a nuisance, and that they did not wish them introduced into the district. On the other hand, all the influential zamindars of the tahsil collected to petition the Lieutenant-Governor that the short-sighted folly of some should not act to the prejudice of all. The Lieutenant-Governor, after hearing the arguments on both sides, decided, on the general question, that those who did not desire a share in the canals need not work

upon them, but that they should not prevent others from doing so * * * The difficulties entailed upon me by this general revolt against the canals were enormous. When the Lieutenant-Governor's orders were issued, with exaggerations, throughout the district, I found my hold on the people completely gone. It is very certain that no great co-operative work was ever yet accomplished, even with a consensus of opinion in its favour, where it was at the option of each individual unit to shirk his share thereof at any moment that the feeling of present laziness overcame the desire of future advantage. * * * I was then in the following position:—I had on my hands a system of incomplete canals; for the credit of the British administration I was bound to complete them; and I had neither funds nor labour wherewith to do so. The season's work to be done comprised 45,355,311 cubic feet of excavation and 6,021,008 cubic feet of dams and embankments, or a total value of Rs. 93,366."

Col. Grey.
29 Oct 01.

1. Q. (The President.)—You are Superintendent of the Bahawalpur State?—Yes.

2. Q. How long have you been there?—Two and a half years. I was there before as well.

3. Q. You have had a good deal of experience of the Punjab?—Yes.

4. Q. Have you had personally to deal with famine relief?—No.

5. Q. In your memorandum you mention co-operative canals. What are they?—Such as the people construct and manage themselves.

6. Q. Why do you say that they should be dismissed from consideration?—The circumstances for their construction were particularly favourable in Ferozepore, but they will never be made again.

7. Q. They were constructed about 25 years ago?—Yes. I saw no chance of anything being done, so I held meetings and invited people to join. The Lieutenant-Governor came over in the second year of construction and determined to see things for himself and the whole matter dropped, so I was in the position of having unfinished canals on my hands. However, I borrowed the money, and the thing was done.

8. Q. The system could not be generally applied?—No.

9. Q. Have you any faith in District Boards being able to work a canal?—In Ferozepore they do. On the 15th of January the headmen meet together and pass the accounts for the previous year and estimate the expenditure for the future; this they distribute over their irrigated lands by a rate which is now about three annas per acre. I don't think it can be done again.

10. Q. You are clear that District Boards could not do it?—Yes.

11. Q. You say in paragraph 4 of your note—"My opinion is that the days of inundation canals have passed, rivers are being tapped to a degree which lowers the value of these works by depriving them of the early and late waters." Will you kindly give some details?—We reckon that we lose one foot of depth at the beginning of the floods and one foot at the end due to the perennial canals. Our statistics show that we lose this.

12. Q. You have got a system of gauges?—Yes, the whole thing has to be thoroughly worked out. It is a very important matter. We have gone as far as possible in meeting the loss by deepening and regrading.

13. Q. You say that a dam can arrest some of the floods for years?—We believe that.

Colonel Gray then described from the map a scheme they had on hand for a canal above Rasul, but which was impossible without a weir. He said there was room for eight to ten lakhs of people.

14. Q. Is the population thick?—The population of the Bahawalpur State is only a little over eight lakhs. There is room for as many more.

15. Q. Is there room for a colonisation scheme?—Yes, on a very large scale.

16. Q. Would the Durbar pay its share in the weir?—Yes. I am putting forward a scheme now.

17. Q. You know no places where water could be stored?—No. There is no place in Ferozepore or in any place I am acquainted with.

18. Q. Do you think people would be contented, having started with canal irrigation, to make wells to carry the crops to maturity?—I have always regretted to see the extent to which canal irrigation throws wells out of use as on the Jinnah Canal. The natural tendency is of course to close wells and take the much easier flow.

19. Q. Do you think it practicable to compel the people to take to well irrigation?—I think it might be done if the canal water were given to the village for a limited area only. The surplus water could then be used to extend irrigation on the canals.

20. Q. Does that mean that the field could be irrigated partly by canals and partly by wells?—With the aid of canals, the well's irrigation of 20 acres would be doubled or trebled. According to my experience, whenever we give inundation canals, the people, on finding the canal water uncertain, sink wells. During the last two years applications have been put in for a little over 11 lakhs. In Bahawalpur we have already paid out Rs. 8,84,000. They find it profitable to have the wells, and I find this a most satisfactory investment of money.

21. Q. Are *takavi* advances given as in British territory?—Yes, but free of interest, and the period of recovery is 12 to 20 years.

22. Q. From your previous experience of districts under British rule, do you think *takavi* advances necessary?—Yes.

23. Q. In Bahawalpur is there a simple way of getting the money?—Yes, the administration wanted to hedge the system round with protective measures, but the people would not take the money till those were relaxed.

24. Q. You have seen mischief done by too much precaution?—Yes.

25. Q. I suppose in Bahawalpur the people are looking with considerable alarm on the proposal for the Lower Bari-Doab Canal?—Of course, the people quite see that even with this canal, if we get a weir in the Sutlej, it will revolutionize the irrigation. (Witness described on the map where the weirs could be placed.)

26. Q. (Mr. Higham.)—What are the facts in regard to the Bahawalpur canals running in the *rabi*?—We have got four running now, which, I think, will run up to Christmas.

27. Q. Do they always run up to Christmas?—Yes.

28. Q. Do the same canals run?—Not necessarily.

29. Q. Are there always some canals running?—I have never known when we have not had one or two.

30. Q. In spite of the fact that the canals have been silted up?—Yes. Working in quicksand is a speciality of the people of Bahawalpur.

31. Q. You mean to say they clear the sand away much lower than the surface of water in the river?—Yes, two or three feet below zero.

32. Q. But you can't get water all through the cold weather; your canal is silted up?—They turn to and clear it out—have been doing this for a great number of years.

33. Q. They get it cleared out before February or March?—Yes.

34. Q. With regard to wells, is it not necessary to have wells to mature *rabi* crops?—It is very necessary. No man likes to put in *rabi* without a well. You might say it is a *sine qua non*.

35. Q. If they flood the land in August or September, they require the assistance of the well later on?—Yes, I think so.

Col. Grey. With reference to a remark which fell from Mr. Merk, we supply borers and boring tools to well sinkers free of expense; we find it well worth the cost.

29 Oct. 01. 36. Q. (Mr. Ibbetson).—Is the assistance largely made up of?—Yes.

37. Q. (Mr. Wilson).—What does Government get from the development of the inundation canals in Ferozepore?—My information is rather stale. It was getting some years ago Rs. 67,000 a year.

38. Q. Owing to enhanced revenue?—Yes—'Water advantage rate.'

39. Q. Has Government advanced money or spent money in developing this system?—No.

40. Q. As Government gets more increased revenue, would it not be reasonable to expect it to improve the canals?—No; a condition which I made for the people was that they should have the canals free for a certain period only, viz., till expiration of the settlement; this came to thirteen years.

41. Q. Do you think that the system by which the people themselves manage their canals and maintain them can be continued indefinitely?—Yes, if you can get the man; if you could get another Maya Das.

42. Q. If you could not, do you consider that Government should continue the management on the present footing or charge a water-rate?—I think the people would prefer doing it alone. The idea is that Maya Das should train a man. That was my idea. He has a man in training in whom he has great faith. I think it would be worth trying.

43. Q. If he does not succeed?—I think the people would prefer being left alone.

44. Q. Suppose Government did charge water-rates, what rates should they charge?—The cost of maintenance Rs. 0-11-6 per acre irrigated plus the present charge of 12 annas per acre water advantage rate. I would not put on more, as Government spent nothing on the work.

45. Q. You said you don't think a similar system of canals could be attempted anywhere else?—I don't think it could.

46. Q. Would you encourage private owners to make canals of their own elsewhere?—Yes. I don't see any objection.

47. Q. Would it be better in future to encourage private owners to make canals or for Government to make them?—My view is that on inundation canals water is largely wasted. The water should be applied to the best purpose only. I am not in favour of inundation canals except so far as an *ad interim* arrangement. Proper scientific principles should be introduced.

48. Q. Is there a large area that can be irrigated from the weir which you propose?—Speaking of Bahawalpur, a couple of fathoms would supply the water to the existing canals in the valley. We will have to feed these canals from the one single head. I believe also that a great mass of the water percolates back from the irrigated land into the river. Some Engineers say that it all comes back. Anyway, I should imagine that this water percolating back into the river will supply means for well cultivation in the valleys. If you have water within 30 feet, it is as good as any man could wish.

49. Q. If you feed an inundation canal from a perennial canal, is there no danger?—I don't see that, if you drop the water by falls.

50. Q. But why should not the Valley Canals continue to work; there will always be surplus water in the river?—Doubtless there is always that with a weir. A portion of the supply will pass on and can be utilized if they sink beds low enough.

51. Q. If the water of the Sutlej were taken out on the left bank, is there sufficient land commandable to utilize it all?—I think there is, in two-thirds of the Bahawalpur State territories where it is level as a billiard table except for occasional sand-hills.

52. Q. That would be commanded by a canal?—Yes.

53. Q. If these weirs were made, Bahawalpur would be prepared to pay a portion of the cost?—As represented by me, yes. I think, too, the Nwab is fully persuaded of the benefit that would be derived.

54. Q. Is there a sufficient sum likely to become available to spend on large works of this description?—I think we could have 40 lakhs of rupees ready in eight years' time. The question won't arise before then.

55. Q. Where would the colonists come from?—They would pour in from Ferozepore and Patiala.

56. Q. You have already British subjects there?—Yes, as far as this canal extends, it is entirely populated by Ferozepore Jats. I got them in 1871-73. They settled on the condition that this canal would be made. The land is now pretty well irrigated. They will not ordinarily settle in the valley. In recent years immigration has been checked by the late Nwab's sporting proclivities; a Jat does not care about being dingied out for three or four days for driving game.

57. Q. And, generally speaking, there is no difficulty in attracting men from British territory?—No difficulty.

58. Q. I understand you advanced about nine lakhs of rupees *lakavi*?—We advanced Rs. 8,84,368, which have been given out without interest. All this has been done in the last two years, 1900-1901.

59. Q. In time, according to your plan, no loss will be incurred as regards payment?—I don't see how loss can be incurred if the well is made. The money is advanced by degrees. The money is put into the soil, and there is the man's holding.

60. Q. You advance the money without interest chiefly owing to prejudice against interest?—Yes, for no other reason.

61. Q. You made a calculation as to what loss would be incurred by the State through not taking interest?—My calculation is attached to my memorandum. I make out that the State gains 20 per cent. even without taking interest.

62. Q. And the State gets, on the expiry of the period of exemption, twenty rupees a year?—An average of twenty rupees a year.

63. Q. In the case of boring tools, are they only used in finding the stratum of water or do they assist in the actual excavation of the well?—No. They only have a diameter of two to three inches. They are screwed in, and if they bring up bitter water or meet *hān* (hard pan), the place is abandoned.

64. Q. The *hān* you speak about in your memorandum is often six or eight feet thick. Is it ever broken through to see what is below?—I don't know. I see scores of wells abandoned.

65. Q. But would not this *hān* be an excellent foundation for the well?—No. It is too near the surface.

66. Q. My idea is to break through the *hān*; would it not be a great assistance: is it not worth trying? Would it not give subterranean water from below?—I daresay. Heenan at great cost and immense difficulty broke through two or three to get pure water. Without that we were plagued with scum, owing to the salts in the shallow wells.

67. Q. (Mr. Ibbetson).—Why do you think District Boards will not manage canals?—The composition of the Board. The Board that manages the canals should be composed of men who are vitally concerned.

68. Q. You have no hope of management by District Boards?—No.

69. Q. One result of a canal being taken over by Government would be that the co-operative labour system would be abandoned and a rate would be charged to cover the cost. That would be very unacceptable to the people?—No, I am not sure that it would. I think they would prefer to pay the value in Ferozepore, but whether it would finally suit them, I don't know. At present any one who does not wish to work pays the value of the cubic contents of his share of clearance, and a contractor is always willing to take it over.

70. Q. It would be a disadvantage on the whole to give up Statute labour?—Yes, I think so.

71. Q. You are very strong on the point that canal irrigation should supplement well irrigation and not supersede it?—Yes. It is the well that supplements the canal; the *rahi* cannot be trusted to the canal.

72. Q. Are you referring to inundation canals only?—Yes, I am not contemplating the great canals that take off from the foot of the Himalayas.

73. Q. You are referring to wells of which the depth of water would not be variable?—Yes; but all canal-fed wells sink slightly when the canal is dry.

74. Q. You don't wish it to be applied to the Sirhind and Jumna Canals?—Hardly that; I think the restriction of canal water and the use of wells to supplement canal irrigation is universally desirable, though on pre-arranged canals the *rabi* is not actually dependent upon wells.

75. Q. You do wish to include the Western Jumna canal? I include the whole.

76. Q. With reference to what you say in para. 5 about well irrigation being supplemented—take the case of a canal of which the flow is continuous. As has just been pointed out, in order to avoid the canal superfluous wells, you would have two distinct areas—a canal area and a well area?—No; that has been pointed out, but I do not agree—I think it perfectly possible to limit the number of canal waterings and leave wells to do the rest.

77. Q. Is it not a fact that on the introduction of a canal the whole agricultural economy changes—for instance big cattle are required to work wells. Would not that create a difficulty?—Yes; as regards the fact, not as regards the difficulty. The canal necessarily itself raises water level and renders the well easier to work.

78. Q. You don't think that difficulty will arise?—No.

79. Q. Though you think the days of inundation irrigations are passed, you would still utilize flood water by inundation canals?—Certainly, till it could be better utilized by scientific canals from weirs. In the construction of inundation canals the money is less well applied, it is better used up on arrangements which will give two hundred acres to the acre.

80. Q. You propose to take away the whole supply of the Sutlej at the beginning and end of the season and

utilize it higher up?—Yes. Of course, that is below Fazilka.

81. Q. How about the people in the valley? No money can compensate them for the loss?—We have talked that over in Bahawalpur, and agree that they will be perfectly compensated by being given sufficient land on this new canal and money to build, while at the same time feeding the existing valley canals as far as possible.

82. Q. You would move them up?—Yes. Of course, it would be a complete revolution.

83. Q. Have you been able to make improvements in the *takavi* procedure?—I think I have succeeded in making considerable improvements in Bahawalpur. We want no inquiry by the Revenue officials.

84. Q. How do you manage to dispense with the Patwari and Kanungo?—We take the particulars of the man's holding out of the settlement file and accept the last entry recorded in the munna papers. I had great difficulty in obtaining this exemption, but I proved the advantage to the Durbar on the evidence of the men who paid large proportions of *takavi* grants to the Tahsil officials, and the Durbar agreed to accept extracts of the revenue records, and that the money should be paid on the spot by the kaddars themselves.

85. Q. A suggestion has been made that Government should make wells in private lands. Do you think the scheme would work?—I cannot imagine it. If a man wanted the improvement, he would make it himself if *takavi* were rendered easy. I don't think he would care about a State encumbrance on his land. The land would not be his own any more.

WITNESS No. 10.—MR. R. SYKES, Director of Land Records, Punjab.

Memorandum on wells.

HISSAR.

The area under well irrigation in the Hissar District, excluding the Sirsa Tahsil, was 1,892 acres in 1892, and the average of five years, 1888-1892, was 1,637 acres only. The reason for this insignificant area was that, except in the neighbourhood of the canal and the Ghaggar and in the central portion of the Bhiwani Tahsil, the depth to water is 100 feet and more below the level of the ground. In the central part of the Bhiwani Tahsil the Bhiwani Bagar water is only about 65 feet from the surface; wells are common; the soil is too porous to retain water in natural tanks, and wells must be made and used for drinking purposes.

2. Elsewhere what few wells there are, are meant primarily for drinking purposes. They are generally near the village side, or round the village tank, and sometimes a little *rabi* is grown on the land attached to them.

3. The cost of building a *pakka* well in the parts where water is at a depth of 80 to 100 feet or more varies from Rs. 1,000 to Rs. 2,000. In the central portions of the Bhiwani Tahsil, where water is near the surface, a well can be built for from Rs. 500 to Rs. 700. In the latter tract temporary *kachcha* wells are much used for irrigation in seasons where the rainfall has been too late for sufficient *khari* sowings. These wells are quickly and inexpensively made and roughly fitted with a rope and bucket. The principal crop grown on them is barley, and when this has been reaped, the wells are deserted and often fall in. They are cleared out and repaired when necessity for their use arises again.

4. To work a well, four pairs of bullocks are required with a driver to each pair and a man to arrange the flow of the water from the water-channel into the beds into which the field is divided. Many of the wells, if constantly worked, become brackish, and even when a small quantity of barley has been sown, it is almost as dependent on the winter rains as if there had been no well. In fairly good years only a few wells are worked for irrigation, but in bad years most of the wells are in operation for a time either for drinking or for irrigation purposes. At the settlement of 1803 a rupee an acre was imposed on well irrigation, but at the revised settlement of the *chahi* land is assessed

as *barani*. There is thus no deferred assessment on account of protective leases for wells.

5. *Sirsa Tahsil*.—The only part of the old Sirsa District in which irrigation from wells is of any importance is Chuk Hithar on the Sutlej. Here water is sweet and within 40 feet of the surface, and near the river it is within 20 feet, and *kachcha* wells can easily be made and worked. The area irrigated from wells varies considerably from year to year. When the floods fail, the people devote all their energies to their wells, but again when the floods are favourable, they sow a great deal of land with the help of the floods and then irrigate a large proportion of it from the wells, and the best crops are most easily got on land which has been moistened and rendered fit for sowing by the river floods and has afterwards had its supply of moisture kept up by irrigation from a well. Although there had been an increase both of wells and of actual irrigation from wells since the settlement of 1853-1864, Mr. Wilson noted that at the time of the settlement of 1879-1883 the villagers of the Ghaggar Valley had not developed irrigation from wells to such an extent as they might. They say that the sandy sub-soil in many places does not allow them to use *kachcha* wells, and that *pakka* wells are too expensive. The cost of construction of *pakka* wells varies from Rs. 200 or Rs. 250 near the Sutlej, where the water level is within 40 feet below the surface, to about Rs. 500 in the Ghaggar Valley, and some of them are liable to be covered by the river floods, but when the floods subside, they can be cleared out and set to work again.

6. *Kachcha* wells are used near the river where water is within 10 or 15 feet of the surface, and cost at most nothing to make, as they are lined only with the stalk of the ear grass or with brushwood (pilchi) and are intended to last for one harvest only. Near the river there is always plenty of water, and the supply in a *pakka* well never fails, and if a *kachcha* well fails in owing to the dripping of the water on its sides, another can be made close by with little trouble or delay. On page 220 of the Settlement Report of the Sirsa District Mr. Wilson writes as follows:—"The supply of water seems to vary partly with the distance from the river and partly with the nature of the strata through which the well is dug. Near the river there is always plenty of water, and the supply in a *pakka* well never fails, and if

Col. Grey.

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Mr. Sykes.

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a *kachcha* well falls in owing to the dripping of the water on its sides, another can be made close by with little trouble or delay. But further off it is found in many parts of the tract that to reach an unfailing supply of water it is necessary to pierce an impermeable stratum of hard white clay (*baggi mitti*) called the *kān*, sometimes 18 feet thick, and wells which only go down to this stratum are dependent on percolation only and soon run dry. Where the *kān* has been pierced even by a hole a few inches across, a constant stream of water comes up from below; but it is often too hard and thick to be pierced by the simple boring rod used by the peasants. This is merely a long bamboo shod with iron, which is raised by several men, struck into the clay and shaken about. A number of wells in the south of the *chak* have been abandoned as useless because the oblong in the course of the river has caused the water-level to sink below the *kān*, and complaints of the *kān* are common about Selemahah, near the centre of the tract." Again on page 6 of the Settlement Report Mr. Wilson gives an account of the underground water-level of the district, and shows that there is evidence that at one time the depth of the water-level was less than when he wrote. It is possible that little engineering assistance to help the villagers to pierce this hard stratum may restore some of the wells to working order.

ROHTAK.

7. There were 2,088 irrigation wells in use in the district and 639 out of use at the last settlement. These are worked by buckets and rope. The average depth to water is only 27 feet as compared with 52 feet, or nearly double in drinking wells. There are a few wells fitted with four or three buckets; nearly one-fourth of the wells have two buckets; the rest are worked by a single one.

8. The unlined wells are generally of larger circumference than the masonry ones, and are of three kinds. The first kind consists of those which are strengthened by a wooden frame work down below as well as by wattling of furash boughs; these are called *Kothewalls* and will last 15-20 years; they cost Rs. 60-70. The second kind have wattling only and are termed *Jharwallas*; they cost Rs. 25-30 and last 10 years. The third class have no protective lining of any kind and are called *Golawalls*; they are few in number, cost Rs. 15 each to excavate, and last, if there is no extraordinary rainfall, for five years. The water in wells affected by canal irrigation has risen enormously since the canal was restored; and there is found in some wells of the low-lying canal villages 50-60 feet of water, showing how far the natural level was once

below what is now has artificially become. The wells in use and out of use are classified as follows, according to quality of their contents:—

	Number of wells.
Sweet water	1,310
Melnsola	546
Matwalla	39
Bitter	604
Salt water	228
TOTAL	2,727

Nearly all the wells out of use belong to the last two classes. The land irrigated by the bitter wells has to be changed every year or two years in order to avoid the excessive development of salt efflorescence. The irrigated area per well throughout the district is ten acres. The cost of masonry wells for irrigation varies from Rs. 400 to Rs. 600. During the last famine many of the wells became brackish and the barley crop grown on land irrigated from them withered. The large increase in *kachcha* wells in this district in the famine years of 1896 and 1899-1900 is very noticeable.

GURGAON.

8. There were 7,186 *patka* and 2,376 *kachcha* wells in use and 1,117 wells out of use at settlement. The average area irrigable per well at settlement was 11 acres. The irrigation is wholly done by ropes and buckets. The higher spring-levels are found near the canal in Palwal, Nuh and Ferozepur and near the Jumna and the Najafgarh and Kotla Jhils. Water is found at greatest depths in the west of the Rawari Tahsil. The introduction of the Agri Canal system into the Palwal Tahsil has caused a very great rise in the water levels. The rise in many places is as much as 30 feet. There is some doubt whether this rise has not caused an increase in alkali efflorescence; the subject is under enquiry. The increase in *kachcha* wells in use in the last few years of drought is very noticeable.

DELHI.

9. There were 6,841 working wells at settlement, of which 6,353 were masonry wells and 1,088 without masonry. The area irrigated by these wells was 61,331 acres for masonry and 16,107 acres for wells without masonry. These are worked by two ways,—firstly by rope and bucket, and secondly by Persian wheel or *harat*. The first kind is used in the southern part of the district. The table given below gives outturn of water with bucket and Persian wheel:—

	Village.	Time of day.	Depth of water.	Pairs of oxen.	Number of men at the poga.	How many muthi ka chara.	Water in one turn.	Number of turns.	Outturn in one hour.
Experiments of one hour's outturn.			Haths.						
Charsa	Senapat	10 to 11 A.M.	5½ 11	2	2 men on poga.	9 . .	3 mds. 18½ srs.	95	340 mds.
Do	Zainpore	11-15 to 12-15 A.M.	9 11	2	Ditto	9, rather short.	2 mds. 29½ srs.	98	267 mds.
								(Rope broken for 1 minutes.)	
Persian wheel	Bogah	12 to 1 P.M.	9 11 8 13 12 10	1 2 2 2	... 2 men on poga.	5½ tinds 9 fall 9 fall	3 srs. 3 mds. 27½ srs. 62 x 2 srs. 11 chs. 3 mds. 27½ srs. 51 x 23 srs. 11 chs.	77 113 107	316 mds. 407½ mds. 325 mds. 6 srs.

It is difficult to estimate the quantity of water required to water a given area, but at different rates of depth some comparative idea may be obtained as follows, taking 340 maunds as the fairest average:—This gives $340 \times 8 \frac{1}{2} = 27,977$ lbs.—a cubic foot of water weighs 1,000 ozs. or 62½ lbs.—so that there would be $447 \frac{1}{2}$ cubic feet nearly poured out in one hour. At an estimate of 1 inch depth

this would give very nearly an acre in a day of eight working hours. The actual extent irrigated is less than this considerably, and the depth greater. The expense of sinking a well, of course, varies very greatly according to the kind of soil in which it is made and the depth at which water is met with. The wells are sunk by men of Jbinwar caste, who get from 12 annas to a rupee per foot of

excavation. The cleaning out of wells depends much on their position; one protected by a masonry coping standing a foot or two above the surface of the ground prevents sand and earth from falling in. The Persian wheel, which has nothing of the kind, requires more attention than the charra. The latter, if kept fairly full of water, needs cleaning only once in five years and often not then.

KARNAL.

Mr. Sykes.

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10. The following figures taken from paragraph 214 of the Karnal Gazetteer show the increase in the cost of a well for varying depths and the area irrigated from wells of different depths. These figures are, I think, fairly representative for this part of the Punjab:—

Number of wells.	DEPTH OF WATER IN FEET.		COST IN RUPEES.		BULLOCKS PER WHEEL OR BUCKET.		Cost of gear.	AREA IRRIGATED PER WHEEL OR BUCKET.	
	From	To	Masonry.	Without masonry.	Number of pairs.	Cost in rupees.		Spring.	Autumn.
1,920	...	20	150	5	2	100	25	8	6
3,752	20	30	225	10	2	125	25	8	6
125	30	40	300	...	4	300	30	7	3
1,464	40	60	550	...	4	400	35	7	3
992	...	80	800 to 1,200	...	4	500	40	6	2

The irrigation is usually by Persian wheel in the Khadir and in the Powadh tract to the north of the Ghaggar, and elsewhere by rope and bucket. Water is found within 30 feet of the surface in the Powadh Circle of Kaithal Tahsil, in the Jumna riverain, and within the canal tract; at from 30 to 40 feet in the lower Nardak and on the Jumna watershed between 40 and 60 feet in the middle Nardak and in the Chika Circle of Kaithal and below 60 feet in all the coastal and higher Nardak. In the Kaithal Nardak and Bangar the water-level is below 100 feet.

11. In the Pipli Tahsil, which has now been attached to the Karnal district, the water-level varies from 19 to 50 feet. The area of crops raised on wells is estimated as follows in paragraph 36 of Mr. Donie's Settlement Report of Karnal-Umballa:—

Pipli Tahsil Circle.	Average depth of wells to water.	Yearly average area irrigated per well bucket.
	Feet.	Aeres.
Bangar	24	10
Northern Chachra	19	13
Southern Chachra	25	7½
Bangar Pehowa	50	8½

In paragraph 37 of this report Mr. Donie discusses the effect of remitting the abiana on wells which had fallen in. It was apprehended that this proposal might make it profitable to abandon existing wells for the sake of the remission of abiana. Under the existing rules, the abiana revenue on a new well is remitted for 20 years from the date of construction. The annual abiana on a well is estimated at Rs. 15 to Rs. 20, and the total remission ("protective lease") therefore amounts to from Rs. 300 to Rs. 400. In certain circumstances, therefore, if a well can be constructed cheaply and loans obtained on favourable terms, it may be more profitable to abandon an existing well and make a new one than to pay the abiana on the old one. This discussion has some bearing on the question whether interest on *takavi* loans should be foregone or not. My own opinion is that the zamindar does not trouble his head with long calculations of the ultimate profit or loss of a transaction extending over 20 years. I think that the Settlement Commissioner proposes to note, on the question whether *takavi* loans should not be advanced free of interest, and I will not here enter into a detailed discussion, but simply record my opinion that the abolition of interest will, in my opinion, do very much to increase the popularity of *takavi* loans both with the people and with the tahsil officials, and that, if it is necessary to protect the rights of Government to a fair return for the money lent, I think that this could be done more conveniently for all concerned by reducing the term of the protective leases on new wells.

UMBALLA.

12. The number of wells in the Umballa District at the last settlement was computed at 5,368, of which 2,613 were unbricked wells. The average depth to water was 39 feet and maximum depth about 70 feet. The depth increases as one proceeds westwards and southwards, but this rule is modified by the effect exercised by the

bill streams in raising the water-level of the Bet and two Chachra Circles. The only parts in which wells are extensively used over any considerable area are the uplands of Pipli and Rupa Tahsils. The wells are only worked in the day-time. Buckets and rope and Persian wheels are used. The well appliances of bucket cost about Rs. 17, and the annual expenditure may be taken about the same sum, for, while some parts of the apparatus last for several years, the rope and bucket, which cost Rs. 6 or Rs. 7, should be renewed twice a year if the well is fully worked.

13. The cost of sinking a well varies in different parts of the district from Rs. 250 to Rs. 375. Four bullocks are required to work a well all day, and in the Bangar Circle there are usually four for each well. In other circles two are often employed, but of course a great deal depends on the means and industry of the cultivator. In the upland circles a good yoke of oxen costs about Rs. 80 or Rs. 90. The price has doubled in the past 30 years, and will prove a hindrance to the extension of irrigation. A good pair of bullocks fully grown now costs at least Rs. 120 to Rs. 150, and they are naturally very carefully looked after. A very noticeable feature of the statistics is the enormous increase in *kachcha* wells during the famine year of 1899-1900. The figures for *kachcha* wells rose from 5,201 in 1898-1899 to 6,928 in 1899-1900, and the area of crops matured by well irrigation was far larger in the famine years 1896-1897 and 1899-1900 than in any other year in the 10 years eyele.

HOSHIANPUR.

14. The number of masonry wells at the last settlement in 1879-1884 was computed at 4,665. Some of the well irrigation is carried on by *kachcha* wells with the Dhangli or lever pole and large watering vessel. Such wells can only water about a quarter of an acre. The irrigating capacity of the masonry wells along the Jullundur border is good; there are good springs of water and the area watered by a well averages 12 or 15 acres, but in the rest of the district the wells are generally worth little, and the average irrigated area is not more than 2 or 3 acres per well. The method of working wells in the south is by the bucket and rope and in the north by Persian wheel. The number of *pakka* wells has increased by 2,083 since settlement. The number of *kachcha* wells in use in this district is always large. Such wells, which are worked by means of a lever pole (Dhangli), can only water about ¼th of an acre, and are generally used only by Samis and Rains for market garden cultivation. Except near the hills, the water level generally lies at 12 or 14 feet from the surface, and thus "Dhangli" irrigation is possible. In the famine year 1899-1900, the number of *kachcha* wells increased from 8,096 in 1898-99 to 15,412 in 1899-1900.

JULLUNDUR.

15. The cost of constructing a well varies with circumstances. Rupees 393-8-0 may, however, be taken as a fair estimate for constructing a double well having a cylinder 60 feet deep and with an exterior diameter of 11 feet. If the owner buras his own bricks, it will cost him about Rs. 280. On the whole, a double well of 40 units can hardly be constructed for less than Rs. 350 under ordinary circumstances. The wells are not plastered. A single well would cost about Rs. 250.

Mr. Sykes.

There are three kinds of wells in the district, i.e.—

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1. Dhiagli or Dbonkli is a lever well consisting of a shallow hole in the ground, sometimes lined with bands of *Sargras*, cotton stalks, tannirak (pilehi) twigs or cane-fibre to keep the sides from falling in.
2. Rope and bucket well.
3. Persian wheel well.

Lever well or Dhiagli well can work about two-thirds of an acre, and on account of its small irrigating capacity is quite unfit for extensive cultivation. It is very little used, and is found in the immediate vicinity of large villages or towns. In seasons of drought hundreds of lever-wells are run up, and the area irrigated by them all taken together is by no

means despicable. The depth of Dhiaglis varies very much, but is not more than 20 feet to the water, and thus only when the well is permanent. The total area returned as irrigated by lever-wells at measurements was only 190 acres. Rope and bucket wells are worked by bullock power, and are invariably lined with bricks set in mud. With one pair of bullocks three men are needed,—one to attend to the bucket, another to drive the bullocks, and the third to attend to the flow of water in the beds into which the field is divided for irrigation. The Persian wheel well is worked by one man, and compared with the rope and bucket system it has many advantages, though its irrigating capacity is less.

16 The detailed statement of wells in existence in the Jullundur District at the time of Settlement, 1881, is given below:—

Tahsil.	NUMBER OF WELLS.							Average depth to water.	AREA IRRIGATED ANNUALLY PER WHARF OR PUCHAT IN ACRES.	
	Masonry.			Other.			Total.		Land.	Crops.
	More than one wheel or bucket.	One wheel or bucket.	Total.	Lever wells.	Others.	Total.				
Norashahr	561	3,484	4,045	13	1	14	4,059	Feet 11 to 27 (20).	15	18
Philloar	732	3,366	4,098	7	...	7	4,105	27	12	16
Nukodar	1,135	5,216	6,350	41	105	146	6,796	9 to 18 (13)	8	11
Jullundur	668	4,783	5,451	197	...	197	5,648	8 to 12 (10).	8	11
TOTAL	3,396	16,848	20,244	258	106	364	20,608	...	10	11

The number of cattle required to work a well depends on the strength of the cattle, the arm attached to the well, and the goodness of the spring. Four yoke of bullocks are, however, necessary to work a well. The Settlement Officer noticed that advances were not taken from Government. The people preferred to go to the money-lender, though he charges much higher interest than Government does. The usual reasons given are the delay and formalities that have to be put up with before a loan can be got, the early date at which repayment has to begin, and the strictness in recovering instalments due, whether the season is good or bad. The extension of well irrigation in the Jullundur district is hampered chiefly by the difficulty of securing an area sufficiently large to find the well full work. It is but

rarely that an enterprising man willing to sink a well has enough land of his own for this purpose. He has constantly to look after for partners who have land near where he proposes building, or he has to effect an exchange of such land for fields of his own lying elsewhere. Either course is often attended with great difficulties. Notwithstanding the difficulties mentioned, the number of masonry wells in this district has increased by 4,182 in last ten years. During the drought the water-supply in the wells was reported to be failing.

LUDHIANA.

17. The following table shows certain statistics regarding the wells existing at the revised Settlement, 1878-1883:—

Tahsil.	MASONRY WELLS.				AVERAGE CAPACITY OF WELL.			
	One bucket.	Two buckets.	Three and four buckets.	Total.	Average depth of wells in feet to the water.	Average cost of construction.	Number of yoke of oxen required per bucket.	Average of crops irrigated annually by each well.
Samrala	1,671	1,005	...	2,756	{ Bet, 10 feet	Rs. 100	2	9
					{ Dhala, 39 feet	350	4	21
Ludhiana	2,845	958	43	3,846	{ Bet, 10 feet	100	2	11
					{ Dhala, 30 to 50 feet	300 to 350	4	19
Jugraon	698	551	100	1,355	{ Bet, 10 feet	100	2	20
					{ Dhala, 30 to 50 feet	300 to 350	4	21
TOTAL	5,214	2,591	149	7,957	{ Bet . . . . .	...	...	12
					{ Dhala . . . . .	...	...	20

Of the total cultivation of the district at settlement 15 per cent. was returned as irrigated and the irrigation at that time was entirely from wells. The depth of water in the wells varies according to locality and season. It is generally 12 or 15 feet, but in a dry year will fall much lower. It is said that during the last five years the level has been high. The amount of water which can be drawn out of a well depends on the source from which it is fed. The supply from beneath the lower clay is inexhaustible, but most wells are filled from the sand and are liable to be worked dry especially where the rainfall has been deficient. The introduction of irrigation from the Sirhind canal has altered the

circumstances of the district entirely. The water level has risen throughout the area commanded by the canal. It does not, however, appear from statistics that the introduction of canal irrigation has been followed by the abandonment of any considerable number of wells. In fact the number of wells which have fallen into disuse in the Ludhiana District is actually less and relatively to the total number of wells in the district very much less than in the neighbouring district of Jullundur which is not canal irrigated. The following figures compare the number of wells, newly made and fallen into disuse, in the two districts since 1885:—

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		1884-85.	1885-86.	1886-87.	1887-88.	1888-89.	1889-90.	1890-91.	1891-92.	1892-93.	1893-94.	1894-95.	1895-96.	1896-97.	1897-98.	1898-99.	1899-1900.
Jullundur	Newly made . . .	...	831	456	623	671	655	858	739	570	352	833	825	470	660	412	660
	Fallen in and disused . . .	...	163	189	185	111	157	69	114	10	190	123	135	60	137	82	113
	Total in use . . .	...	20,620	21,302	21,771	22,250	22,710	23,103	23,785	21,611	24,703	21,915	25,107	25,487	29,019	29,350	26,807
Ludhiana	Newly made . . .	142	73	76	102	116	144	233	214	117	147	113	101	135	167	339	297
	Fallen in and disused . . .	20	63	66	93	116	71	73	12	3	26	35	39	43	61	80	45
	Total in use . . .	6,204	7,457	8,115	8,208	8,214	8,243	8,414	8,63	8,034	9,035	9,136	9,201	9,203	9,399	9,672	9,624

FEROZEPUR.

18. There were 5,753 wells in the district in 1898-99, of which 5,179 were *pakka* and 579 *kacheha* wells. These are worked both by Persian wheel and bucket and rope. Depth to water varies according to locality from 20 to 80 feet, and cost of construction of masonry well varies with the depth to water from Rs. 100 to Rs. 900, and of *kacheha* well from Rs. 5 to Rs. 50. Three to six pairs of bullocks are required to work a well, which cost from Rs. 200 to Rs. 475. Cost of gear similarly ranges from Rs. 35 to Rs. 60. In the spring from 2 to 18 acres can be cultivated by one wheel or bucket, and in autumn from 1 to 15 acres.

MOOLTAN.

19. The general statistics for wells in the Mooltan District may be summed up as follows (average of five years ending 1898-1899):—

Wells in use . . .	16,958
Wells not in use, but capable of use . . .	5,036
Wells become incapable of use . . .	192
Wells newly brought into use . . .	431
Total number of wells . . .	19,619

20. In the richest part of the district well irrigation is resorted to merely as supplementary to irrigation by canals, and is of primary importance only in the northern and eastern taluqs. Throughout the district it may be broadly stated that there is no plot of cultivation in which there is not a well of some kind used for watering. They are of all kinds from the brick well sunk in the high lands to the unlined *kacheha* holes dug from year to year in land which is subjected to inundation during the floods. The distance of water below the surface rapidly increases with the distance from the rivers, and the depth of the well ranges from 10 to 100 feet; but from 25 to 30 feet may be taken as about the average depth of a brick well. When it rises beyond 40 or 60 feet, cultivation becomes impossible. Most of the cultivation in the Mooltan District is found in the valleys of the Ravi, Chasab and Sutlej. The inner triangular-shaped central area, known as the *Rawa*, untouched by the canals, where wells are of great depth and sparsely scattered at wide intervals, is, except in rare localities where it hollows rain water settles, a barren, desolate, treeless plateau of hard soil almost uninhabited at present, but only requiring the advent of a regular supply of canal water to make it as fertile and thickly peopled as the most favoured parts of the district. In the *Rawa* wells permanently independent of river irrigation are few and scattered about the portions of the *Rawa* which are furthest from the river. They cost from Rs. 600 to Rs. 700, besides the additional expenses caused by the absolute necessity to build houses for the tenant round each well. The cultivation on such wells is fairly constant, the wells are carefully kept up; tenants are ready to stay on account of the facilities for grazing. The wells are deep, and at least six yoke of strong oxen are necessary for a properly equipped well, and some 12 or 13 acres only can be

cultivated each year from each well. The second class of cultivation in this district in which wells play a part is that which relies also on inundations received through cuts from the river. Wells partially dependent on the supplies of river cuts are found in the higher parts of the *Ilithar* as well as in the *Utar* and *Rawa* circles. The cuts will, in a good year, run for a fortnight or so "off and on" during the summer; in an ordinary year they run for two or three days, and in a bad year, that is in about two years out of every six, they practically do not run at all. Such is the character of the soil, and the character of the silt which the inundation brings is such that even after a single day's superficial inundation and without any further assistance from wells or rain a very respectable crop of wheat can be matured. The assistance of wells or rain though not necessary is of course advisable, and about half the wheat sown on the *sailab* is matured by wells, while good winter rains are always looked for to improve the other half. The extreme capriciousness of inundation and the fluctuations in the area benefited by it have a bad effect on the cultivation. In a good year a well may spread its cultivation over 18 or 21 acres, and in a bad year it is allowed to fall into a state of semi-repair, and eight acres of crop only are matured from it. The tenants leave, and new tenants refuse to take up the land. And if the month of the out is not kept clear, the well falls in, and the fields relapse into jungle. The wells which are also assisted by canal irrigation have an average area of crops of some 35 to 40 acres per well.

JHANG.

21. The revised settlement of the Jhang District was made in the years 1874-1880, and enumeration of wells taken in 1878, for Major Wace's Famine Report showed that there were 10,867 wells in the district, the depth of which varied from 20-40 feet, and 15 to 16 acres were irrigated in spring and 6 to 7 in autumn. The cost of masonry wells differed from Rs. 185 to Rs. 350 and the cost of a *kacheha* well was Rs. 25. Of the 10,867 wells 40 were unbricked, while all were worked by Persian wheel. The wells in the upland of the Chinot Talsil were deeper than in any other part. The wells in the villages fringing the river bank were usually less than 20 feet deep, those in the villages beyond were in the northern half of the district from 15 to 25 feet and in the remaining tract 30 feet or over. The people have various modes of dividing the water of a well. So many "*pahrs*" of three hours each are allotted to each share, and after a fixed period the times of the "*pahrs*" are changed. If the well is held on three-thirds and four one-centime "*pahrs*" are allotted to each third, then the yoking times change of themselves, i.e., A, B and C hold a well and each works the well for four "*pahrs*." A's turn at the well, if from midnight to midday on Monday, will be from midday to midnight on Tuesday. Similarly if a two "*pahrs*" turn is allowed to each proprietor of one sixth the time of each turn changes in regular order. A turn is never less than two "*pahrs*," or 6 hours, and never more than eight "*pahrs*," or 24 hours. A pair of

Mr. Sykes. bullocks works six hours at a stretch. The area irrigated by wells differs considerably. The following is Mr. Steadman's estimate in acres of the areas irrigated by unassisted wells in the various parts of the district:—

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CHINNIOT UPLAND.		JHANG UPLAND.			Shorkot upland.
East of Chenab.	West of Chenab.	Between Chenab and Chaj Bar.	Along Jhelum.	Between Chenab and Sandal Bar.	
Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
30	26	24	20	17	16

The following table gives the average areas attached to each well, including fallow, in acres as ascertained at the settlement:—

TRACT.	CIRCLE.			
	Centre.	Bar.	Utter.	Kashbi.
Chiniot . . .	26.5	26	90	...
Jhang { Jhelum . . .	20.7	...	...	13.5
{ Chenab . . .	16.5	16.8	21.5	...
Shorkot . . .	15.9	15.4	...	15.8

The irrigating power of *kachcha* wells in the river-side villages is about one-fifth less than that of masonry wells. They are liable to dry up.

MONTGOMERY.

22. The greater portion of the cultivated land of the district is watered from wells of which there were 10,881 in the district in 1896-97, and of these 6,688 were in use. Water is raised by Persian wheel. There are *pukka* and *kachcha* wells in the district. The depth of the wells to the water varies from a few feet along the rivers to about 60 feet or more in the Ganji Bar and Sandal Bar. The cost of a well and the area it can irrigate annually depends very much on the depth to the water. The area a well can water depends so much on the nature of the soil, the character of the season, the quality of the cattle employed and the industry of the cultivator. Mr. Purser found the average area irrigated in the spring was just $3\frac{1}{2}$ acres per yoke, in fair average soil with water 20 feet from the surface. The area however varies in different parts of the district: fair averages would be 25 acres in Dipalpur, 20 acres in Pakpattan and Guggera, and 15 acres in Montgomery. Including *chahi-nahri* and *chahi-silaba* more than 30 acres might be irrigated from a well. The cost of constructing a single-wheeled *pukka* well varies from Rs. 250 to Rs. 550. The cost of sinking a well, which was 40 feet deep and one mile from the brick kiln, is given by Mr. Purser as Rs. 810-7-8. Sometimes double Persian-wheeled wells are built. These are called *crane*. Its cylinder has an interior diameter of about 15 feet. It costs about one-quarter or as much as one-third more than a single well of the same depth. When the water is near the surface and the supply good, such double wheeled wells are common. In this district wells have no openings. They are filled by percolation. In some cases the water level is not much reduced, while in others it is reduced by ordinary working of the well. If a well is not subject to much influx of sand it is cleaned out once in ten or twelve years, but otherwise in five or six; *kachcha* wells are found near the river. They can stand for four or five years, but the average period may be taken as two years. They cost about Rs. 20. A well with six yokes will irrigate about five *canals* or $\frac{1}{2}$ th of an acre in 24 hours when the water is 25 feet deep from the surface, but if there has been good rainfall 6 or 7 *kanals* can be watered. The deeper the water and the more sandy the soil the less the area irrigable. During the hot months irrigation is carried on only during the night. Laundering canals have considerably raised the water level in the wells.

LAHORE.

23. Two kinds of wells are used in the district,—the Persian wheel and the Dhangli. The Persian wheel costs

from Rs. 200 to Rs. 600 according to the depth of the water. The Dhangli or *kachcha* well costs from Rs. 30 to Rs. 40 to build. There were 12,996 masonry wells in the district at the time of the Settlement, 1893-94, of which 608 have two wheels and 4,879 unlined wells. The number of masonry wells now in use is 14,937. The statement given below shows the depth of water and average cropped area of wells in different parts of the district according to the information collected at settlement. But no wells would crop as much as is shown in the statement unless they were provided with at least six yoke of oxen in the Manjha and five yoke in the low land tracts:—

Name of tract.	AVERAGE DEPTH OF WELL.			Average area cropped.
	To water.			
	Maximum.	Minimum.	In water.	
Manjha . .	52	20	16	22
Hithar , .	25	65	6	28
Ravi villages .	28	12	8	20
Trans-Ravi . .	54	16	7	24

The wood work by means of which the well is worked costs a considerable amount and requires to be constantly repaired or replaced as it wears out under continual use. Its first cost ranges from Rs. 40 to Rs. 60 and the annual cost of repairs varies from Rs. 12 to 20. The cost of the wood work falls on the owners and not on the tenant. The course of cropping on wells varies in different parts of the district. In the sweet water well of the Manjha out of a total area of 25 acres between 4 and 5 acres would be sown for the kharif harvest and about 22 acres for the rabi. The reason for less land being sown in the former than the latter is that there is much less time for preparing the land in the summer than in the winter months. In the western Manjha where the wells are hither the autumn cropping is very limited and the spring cropping is almost all wheat with a little barley. In the Hithar tract, where well areas are large and there is little pressure on the land, the rabi cropping covers a much more extensive area than the autumn cropping; the latter occupies 10 acres and the spring cropping 16 acres.

AMRITSAR.

24. Of the irrigated area of the district 242,919 acres or 60 per cent. is irrigated by wells. There are 10,666 masonry wells, of which 1,317 are fitted with two wheels. The apparatus used is the Persian wheel. The cost of sinking a well varies with the depth; where the water is deepest near the high bank of the Beas it is as much as Rs. 500. In the central or canal-irrigated parts of the district, where by percolation the water level has risen 10 or 15 feet in the last 30 years, a well can be sunk for from Rs. 250 to Rs. 350. The cost is not more than Rs. 120 to Rs. 170 in the low lands near the Beas and Ravi. The average depth down to the water is 20 feet in the Amritsar Tahsil, about 22 in Tarn Taran and only 16 in Ajnala. Where wells are shallowest the depth is 10 to 14 feet, but in villages near the Beas it may be as much as 50 feet or more. From three to five pairs of bullocks are required to work a well continuously for 24 hours, and 2 bullocks can be watered; but the area will vary according to the depth from which the water has to be raised, the distance of the fields from the well the slope

and the nature of the soil through which the water has to travel. The apparatus costs from Rs. 30 to Rs. 50 and will last many years if well built, but the rope ladder soon wears out after a couple of months of constant work and soaking. It is impossible to say how long a well will last. It depends much upon the care with which it has been built, the composition of the stratum on which it rests, the absence of Kalar in the clay of which the bricks are made and other considerations. But there is no doubt that many wells are at work now which were built close on a century ago. They are of course subject to many defects, a cave may form in the side of the cylinder, the spring may be insufficient or be

choked by the clay through which it has to come or there may be an inflow of sand interfering with the draught of water. Yet many wells continue to work for years with defects which seriously interfere with the supply of water and the rise in the water level, which has taken place all over the district, has had the effect of making workable wells which long ago were abandoned on account of some defect.

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GURDASPUR.

25. The table given below gives information as to the depth and irrigating capacity of the wells at the time of the settlement of 1891-92 :—

Tahsils.	NUMBER OF WELLS.			Average depth to water working.	Present depth.	Average area irrigated.
	Single.	Double.	Total.			
Gurdaspur	850	272	1,122	8	24	21
Batala	2,001	620	3,591	6	28	33
Shakargarh	638	27	665	5.5	18.4	13
Pathankot	20	...	20	4	21	3
District	4,469	929	5,398	6.8	21	28

It has generally been assumed that irrigation is not much required in this district, but, though not so vitally important as in other parts of the Province, it is most necessary to ensure security of outturn and to render possible cultivation of higher staples. Owing generally to the rapid slope of the country wells are not practicable in the northern half of the district, and roughly speaking it may be said that very few of these are to be found to the north of the main road from Hoshiarpur to Sialkot through Gurdaspur and Shakargarh. South of this however they become more frequent and in the Batala Tahsil form an important feature in the agricultural condition of the country. Even here, however, they are not absolutely essential, but are used rather as a means of supplementing any deficiency in the ordinary rainfall than as a remedy for the want of this.

SIALKOT.

26. Of the total area at present recorded as irrigated 90.7 per cent. is served by specially constructed water-lifts which in the vast majority of cases take the form of Persian wheel. There are now 20,635* wells in the district which are worked by the Persian wheel. The following table† gives the well statistics for each tahsil :—

Tahsil.	Total number of wells.	TOTAL AREA FIDMANTLY SERVED BY WELLS.		Average well irrigated area per well, in acres.
		Actual.	Per cent. on total cultivated area.	
Zafarwal	3,235	57,315	36.0	17.7
Rayo	4,560	90,350	46.8	19.9
Pasrur	3,532	83,316	44.0	23.6
Sialkot	4,075	83,389	40.0	20.2
Dasko	5,233	162,419	88.1	31.0
TOTAL	20,635	477,289	5.10	23.1

The depth to water varies from a few feet in riverain tracts to as much as 55 feet in the centre of the district where the lifting power required involves a very heavy strain on the cattle. The cost of sinking a well therefore varies according to the depth, the geological formation of

the soil and the extent to which the owner and his following assist in the operation. It may, however, roughly be taken to cost from Rs. 120 to Rs. 500. Double-wheeled wells cost about 30 per cent. more. It is difficult to fix the average age of a well. If repairs are carried out, whenever necessary, a well will last for 100 years; but in some tracts like the low-lying Nonda Circle of Sialkot, the Daro country to the east and parts of Zafarwal wells rarely last more than 40 years and sometimes fall in after 15 years. *Kachcha* wells are found in the north of Zafarwal and in the Degh Valley. A *kachcha* well can be constructed in three or four days and costs nothing.

GUJRAT.

27. There were 8,607 wells in the district in 1891-92, and they watered 214,369 acres of land, the average well area being 24 acres. An estimate of the profits of an average well was thus made by Colonel Waterfield. The difference between the produce of the 20 acres unirrigated, Rs. 112-4-0, and of the same land under well irrigation, Rs. 198-4-0, is shown to be Rs. 86 per annum. The cost of working it is shown to be Rs. 55, leaving Rs. 31 to the owner of which Government takes its share. But the cost and expense of wells differ very greatly. In the Bar a well costs Rs. 500 or Rs. 600, whilst the cattle required must be buffaloes, and the rope itself 210 feet long. Twelve are used in the year which cost Rs. 30. In Tahsil Khorion water lies very deep, and a large majority of the wells are made rather for the purpose of supplying water to men and cattle than for regular use in irrigating the land. In the upper part and central portion of Gujrat water lies deep, the rainfall is good and wells are not a necessity for cultivation. In the south-western portion wells are more necessary. In the Phalia Tahsil wells are required for *rabi* cultivation. The average area of *chahi* land to each well is 10 acres in Bulandi Circle, 22 acres in Hithar and Jatatar Circles; the average in these circles is raised by the wells found in the south-west of the tahsil, where the area is often 30 to 35 acres. In the Phalia Tahsil the average area is in—

	Acrea.
Bet Jhelum	25
Bar	34
Hithar	40
Bet Chenob	27

GUJRANWALA.

28. According to recent statistics the proportion of each class of soil to the total cultivation was as follows :—

	Acrea.
Chahi	56
Chahi-nahri	2
Nahri	13
Sailaba	4
Borraoi	25

* The latest figure is 23,133.

† Figures taken from Assessment Reports.

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Wells are, therefore, the mainstay of the agriculturists of the district. They are either *pakka* or *kacheha*. A *pakka* well costs from Rs. 150 to Rs. 750 according to the depth of the water and lasts from 30 to 100 years. *Kacheha* wells are found near the river where *pakka* wells cannot be sunk on account of floods. They cost from Rs. 20 to Rs. 30, irrigate only a few acres, and last for two or three years. The amount of land irrigated by a *pakka* well depends on the nature of the soil, depth of water, condition of the wall and the number of yokes employed. A well with eight yokes worked day and night will, however, irrigate 40 acres, but 30 acres may be reckoned as average; whilst in years of scarcity or drought not more than 20 or 25 acres can be cultivated on. In the Bar land one yoke can irrigate 5 acres in the year, whilst in the Bangar and Khadir it can irrigate 7 or 8 acres. There are 12,218 masonry wells at work with an average area, of 39 acres of land attached to each. The well mahal or Persian wheel or *charkhari* mahal occupy the eastern portion of Gujranwala and Wazirabad Tahsils. Here the water level ranges from 20 to 32 feet below the surface, and about 90 per cent. of the cultivation depends on wells. Along the river in Wazirabad and Hafizabad the spring level varies from 12 to 20 feet. The well irrigation is 80 per cent. in Wazirabad, the spring level varying from 12 to 20 feet, and the average area per well 34 acres. Gujranwala stands next with 71 per cent. cultivation, water level varying from 25 to 55 feet, the average area per well being 40 acres. Hafizabad Tahsil is at a disadvantage as the water level is so deep that the expenses of sinking wells and of maintaining them in work is very heavy and in some cases prohibitive. The area irrigated is 40 per cent. water level from 15 feet to 80 feet and the average area per well 43 acres. The above will show that though 60 per cent. of the cultivation is protected by wells, the success at least in Gujranwala and Wazirabad depends to a great extent on rainfall. A tract of country depending entirely on well irrigation has its special danger, namely, the loss of well cattle in the time of drought. This danger is very clearly shown in a note by Mr. O'Dwyer, the Settlement Officer of Gujranwala. In reporting on the subject of secure and insecure areas he writes as follows concerning the Charkhari Circle of that district: "The wells being numerous, the water level near and the supply excellent, the Charkhari Circle with 93 per cent. of the cultivation, Chakwal and the Bangar with nearly 90 per cent., Chakwal should be as secure as any tract in the Central Punjab. Should, however, the drought extend over more than two harvests, its effects, become very serious in well tracts. The well cattle become emaciated from over-work and under-feeding. Most of the crop goes in fodder, the water-supply runs short and the loss of cattle which die of starvation or become prematurely worn out hits the proprietors of these tracts harder than elsewhere, as they have no reserve of their own from which to replace them and have to borrow money for the purpose at usurious interests. If no leniency is shown in exacting the revenue in such seasons, the burden of debt and its consequences—the transfer of the land to the money-lender—increases to an alarming extent. If then the drought extends to a third harvest in succession, suspension of at least half if not of the whole demand should be fairly given, and it should be borne in mind that, as the revenue demand and the expenses of cultivation are heavier on well than on unirrigated lands, they take longer to recover from the effects of prolonged drought and the realization of the suspended demand should therefore, as a rule, be spread over two harvests."

SHAHPUA.

29. The number of wells in use is 6,865. The average area irrigated per well is 34 acres, and the area harvested 25 acres.

In the river valleys and those parts of the Bar uplands which adjoin them the sub-surface water is almost everywhere sweet, but in a small belt of land running from Dhakwan to Kot Pahlwan the sub-soil water is impregnated with salt to such an extent as to injure the crops in dry years; there is some reason to believe that in this tract the effect of the spread of the canal irrigation has been to increase the saltness of the well water, and the silt of the crops irrigated from wells should be watched. In the Bar upland the water is often brackish and unsuitable for irrigation. In the plain portion of Khushab Tahsil, except in the narrow strip near the river, the sub-soil water is quite impregnated with salt and the irrigation from wells is almost unknown. In the Salt Range the sub-soil water in the bosom of the valleys is generally sweet. In the river valleys the depth varies from about 15 feet near the river to 40 feet near the edge of the Bar. But in the Ara Circle in some places about 10 miles from the river, water is not found

within 55 feet from the surface. The introduction of canal irrigation in the Jhelum Circle has had a marked effect in raising the water level where instead of 200 pots on the Persian wheel only 150 or less are now required. In the Bar uplands the depth of the water varies from 50 to 80 feet, and many wells require 400 pots on the Persian wheel. In the Thal the depth of water is 55 feet or more.

30. The cost of a well depends chiefly on the depth to water and varies from Rs. 150 to Rs. 500 or more in the Bar. An ordinary well in the river valleys costs about Rs. 200 besides the peasant's labour. The wood work of a Persian wheel costs Rs. 30. In the river valleys small bullocks can work the well, but in the Bar male buffaloes, costing about Rs. 60 or more, are required. Here a well in full work requires 18 buffaloes. The average area attached to a well is 34 acres and the average area harvested is 25 acres. In the Ara Circle 54 acres is an average area attached to a well, but only 24 acres give a crop in the year; in the Salt Range the area attached to a well averages only 2½ acres, but produces 4½ acres of irrigated crops annually.

JHELUM.

31. The following statement shows the number of wells in the different tahsils in 1896-1897:—

Tahsil	Pakka wells.	Kacheha wells.
Pind Dadan Khan	1,220	23
Chakwal	1,578	57
Talagang	889	138
Jhelum	924	138
	4,621	356

Many of the wells in the Pind Dadan Khan Tahsil are tainted with *shor*; they are not well built. The water-level is 14 feet below the surface and the area irrigated (*ohahi* area) is 18½ acres per well. On an average 100 acres of well land will give 105 acres of harvested crops during the year. In the other tahsils well cultivation is very different; the country is interspersed with ravines, and the wells are situated in the strips of moist alluvial land which form on the banks of the torrents, wherever they broaden out; water is found at a moderate depth, and the wells built roughly but strongly of unmortared stone cost little to make; the expense of course varies greatly, but an average well may be taken to cost from Rs. 100 to Rs. 125 plus about Rs. 45 or Rs. 55 for the wood work. The area commanded by these wells is very small seldom exceeding a couple of acres, often much less, and this too, generally split up between a number of co-sharers; the cultivation therefore is generally of a fairly high class. The wells are, however, often dependent on the rainfall to a great extent, for in time of drought the supply of water runs very low, in extreme cases failing altogether. The wells are generally amply provided with cattle, owing to the sub-division of the land attached to them between several owners or tenants. They are generally worked by buffaloes, two or three one per well being sufficient.

RAWALPINDI.

32. The total area of the district amounted in 1887 to 31,979 acres, of which 18,511 acres were irrigated by wells. Persian wheels are used. In Attock Tahsil they are made with bricks and lime, in other places with stone and lime. The depth of the wells varies in the different tahsils, the average in each being—

Rawalpindi	18 feet
Attock	19 "
Khushab	9 "
Pindigheb	15 "
Gujranwala	11 "
Fatahjang	20 "

There were in all 5,302 wells in the district, of which the following is the detail:—

Tahsil.	Masonry wells in 1892-1893.	Kacheha wells, <i>Ohenkila</i> and <i>Jhailars</i> in use during the year 1892-1893.	Grand Total.
Rawalpindi	602	179	781
Attock	1,886	222	2,108
Kahuta	36	27	63
Pindigheb	1,080	88	1,168
Gujar Khan	337	219	556
Fatahjang	1,589	110	1,699
TOTAL	5,530	845	6,375

Wells are commonest in the Chhbach Circle of Attock and the Sil-Soan Circle of Fatahjung. The average cost of a masonry well is about Rs. 450 and of *kachcha* well Rs. 100. A double-wheeled Persian well in Chhbach, however, would cost Rs. 1,000 to Rs. 2,000. The average area irrigated from each well is 3½ acres, but it varies from one acre in Gujar Khan and Kahuta and two acres in Rawalpindi up to five acres in Chhbach: single wheels are worked by a single bullock costing about Rs. 20 to Rs. 30. The cost of a pair of bullocks required to work a double-wheeled well is about Rs. 50. The cost of the plant of the well is from Rs. 40 to Rs. 70 where there is one Persian wheel and Rs. 80 to Rs. 100 in case of double-wheeled well.

HAZARA.

33. The only tract in Hazara in which wells are used for purposes of irrigation are Khari on the Indus bank, the Kot Najib-ullah and Jugal in the Haripur plain. In Khari there are 58 wells which water 236 acres. The depth of the wells from the surface of the water varies from 14 to 23 feet. The diameter is in most cases 9 feet, but there are some wells of 12 feet for double gear. They are constructed of *kachcha* boulder masonry, the boulders being in hand in abundance in the bed of the Indus and in the ravines. Their average cost is from Rs. 100 to Rs. 300 according to depth. All the well lands bear two crops, and

both crops are remarkably fine; the well lands are close to the village sites, and manure is applied without stint. In Kohat Najib-ulla 34 wells irrigate 107 acres. They are sunk in the low land and are liable to destruction by diluvion. They are built with the boulders and are worked by the Persian wheel. The little land attached to them is generally of first class and pays from Rs. 12 to Rs. 20 per acre. In Ilaka Jugal there are 20 wells, but are inferior to those in Kot Najib-ullah.

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PESHAWAR.

34. Well irrigation is resorted to in the eastern half of the district where the depth of the spring level admits of this, and since the commencement of British rule it has assumed considerable importance in Swabi and Nowshera, and wells are being freely sunk wherever practicable. The chief statistics of interest concerning wells can be gathered from the table below, which does not require much explanation. In Yusufzai the soil is sufficiently firm to admit half of the wells being worked without a complete masonry lining and even without a lining at all, more especially as the area attached to each well is so small as to render it unnecessary to work the well continuously and heavily. The aridity of the climate and the onerous system of distribution of the village lands between the sharers in strips conduce mainly to limit the area attached to each well.

Statement showing cost of cultivation and repairs and method of working wells in the Peshawar District.

Tahsil.	NUMBER OF WELLS.				AVERAGE AREA PER WELL IN ACRES.		NUMBER OF WELL CATTLE.		COST PER HEAD.		COST OF SINKING IN PLAIN AND OF REPAIRS IN ANTIQUE FIGURE.	
	Under 20 feet to water.	From 20 to 30 feet depth.	Over 30 feet depth.	Total.	Land.	Crop.	Bullocks.	Buffaloes.	Bullocks.	Buffaloes.	Sinking.	Gear.
Charsadda . . .	45	15	5	65	5	11	73	122	30	43	176	48
							or 3 per well.				8	10
Mardan . . .	697	787	318	2,032	5	0.3	5,886	757	27	33	136	49
							or 3 per well.				4	4
Swabi . . .	2,002	2,449	1,413	5,864	3	5	13,423	4,841	20	31	132	35
							or 3 per well.				4	4
Peshawar . . .	79	120	30	229	6	10	365	54	48	27	132	50
							or 4 per well.				6	4
Nowshera . . .	503	423	323	1,248	7	10	6,004	1,331	27	41	252	46
							or 6 per well.				4	3
District . . .	3,526	3,793	2,119	9,438	5	9	26,345	7,105	31	35	166	64
							or 4 per well.				5	5
Pakka . . .	2,352	1,675	503	4,530								
Kachcha } . . .	251	542	191	984								
Pakka } . . .												
Kachcha . . .	923	1,576	1,425	3,824								

KOHAT.

35. There were at the time of settlement 103 wells in use in the Hangu Tahsil and 75 in the Kohat Tahsil. The average depth to water varied in Hangu from 12 to 18 feet and 20 to 43 feet in the Kohat Tahsil, while the cost of construction ranged in the Hangu Tahsil between Rs. 33 and Rs. 43, and Rs. 90 and Rs. 203 in the Kohat Tahsil. There are 54 wells in the Khattak ilaka, of which 43 are in use. The chahi area is only 145 acres or about 3 acres per well.

BANNU.

36. There were 204 wells in the district in 1878, of which 13 were unbricked. Of these 101 were less than 20 feet deep, 45 between 20 and 30 feet, 60 between 30 and 40 feet, and 88 between 40 and 60 feet. The Bannu District is, as a whole, unsuitable for well cultivation because of the great depth of the water level. There were no irrigation wells at all in the Bannu Tahsil and only two in Marwat, besides 9 jhallas on the banks of the Gambilla. In Isa Khel and Mianwali there were at the time of settlement

only 281 *pakka* and 13 *kachcha* wells and jhallas in use. The average area irrigated in one year from a well was only about 3 acres. The finest wells are those in the southern part of the Mianwali Thal, but their working is expensive, the depth to water being from 35 to 47 feet. There were also some profitable wells near the high bank of the Indus on the Isa Khol side. Unlike the Indus kachcha of Dera Ismail Khan District, that in Bannu has few wells. The constant shifting of the channels of the river and the height of the summer inundations hardly permit of their construction. The few existing only supplement river inundation and percolation, and are more for drinking than irrigation purposes. The cost of a *pakka* well of a depth of 40 feet would be as follows:—

Excavation and masonry lining . . .	Rs. 300
Gear	80
Two yokes of oxen	75
TOTAL	455

Mr. Sykes. Well cultivation might be advantageously introduced or extended in and about the Bhittani settlement of Harnamata in Morwat, in the southern parts of the Mianwali Thal and along, and in places under the high banks of the Indus. The number of masonry wells in the district according to the return of 1899-1900 were 541; there

has thus been a slight increase in the number of wells since the Settlement Report was written.

DERA ISMAIL KHAN.

37. The following information regarding wells was collected at last settlement :—

Tahsil.	WELLS.								
	In use.		Masonry wells out of use.	Depth of wells in feet to water.	Cost of constructing.	Pair of bullocks per well.		Area usually irrigated per well.	
	Masonry.	Jhalirs.				Number of pairs required.	Total cost per well.	Rabi.	Kharif.
					Rs.		Rs.		
Dera Ismail Khan . . .	547	...	169	17	400	3	150	10	5
Tank . . . . .	...	...	...	...	...	...	...	...	...
Kulachi	32	7	14	10½ to 41	250 to 400	3 to 6	120 to 600	10 to 23	2 to 7
Bhakkar	1,891	61	146	11½ to 28	200 to 375	3 to 4	120 to 340	10 to 18	3 to 6
Leiah	3,223	253	835	22	310	4	220	15	4
TOTAL	5,193	321	1,164	...	...	...	...	...	...

The cost of gear varies from Rs. 35 to Rs. 50. Out of 5,193 wells, 2,659 wells in use were in the Thal. Of these 635 were in the Bhakkar Tahsil and 2,024 in the Leiah Tahsil. The depth of wells in the Leiah Thal varies from 20 feet to 36 feet. In the Bhakkar Thal the average depth of wells is 38 feet in the Daggur and 51 in the Thal Kotan Circle. These deep wells necessitate expensive cattle to work them till at last the expenses eat up the profits. As a rule no profit is to be obtained by letting out wells to tenants, and if a man cannot cultivate his own well, he is generally glad to make it over to any one who will pay the revenue and a nominal malikana. Large allowances, however, have to be made for green fodder eaten by the cattle and the expense of keeping the well in repair, which fall on the proprietor. In sinking a well in the Thal, besides looking to the depth to water, the zamindar has to look to the nature of the ground. He tries to get a level plot of some 40 or 60 acres. If he is unable to get a level plot of sufficient size, much trouble is entailed in smoothing down sandhills and levelling the ground before he can increase the area to the requisite extent. Perhaps he leaves the sandhills alone and goes in for cultivating what level land there may be without regard to its position, but these awkwardly shaped plots lead to great waste in the distribution of the water and interfere with the symmetry which is the beauty of the Thal well cultivation. Wherever the amount of land attached to a well allows of it it is cut up into segments corresponding with the shares on which the cultivation is held. These are separated from one another by the main water channels and footpaths which radiate from the well with mathematical precision. The commonest division is into six segments, each comprising a sixth of the well lands. Most of the wells

in the North-Eastern Thal are *kachcha*, but the wood of which these are made is daily getting scarcer and *pakka* wells are now being sunk in all directions. The total number of masonry wells is now 6,903.

DERA GHAZI KHAN.

38. The total number of wells in the district, as ascertained at the revision of settlement in 1893-1897, is given below :—

Tahsil.	WELLS.		
	In use.	Out of use.	Total.
Dera Ghazi Khan . . .	5,456	183	5,639
Sanghar	469	81	550
Jampur	1,339	148	1,485
Rojanpur	1,088	364	1,452
TOTAL	8,352	776	9,128

In the deeper wells in the Paband, which have been made for drinking purposes only, the rope and bucket are used. The average depth of wells and the area that can be irrigated will appear from the following table :—

Tahsil.	Assessment Circle.	DEPTH OF WELL.		
		To water.	To bottom.	Average area attached to well
Dera	Chabi-nahri	12 or 14 feet	21 or 22 feet	24 to 27 acres.
Jampur	Sind	12 or 14 "	21 or 22 "	21 to 27 "
Sanghar	Chabi-nahri	16 "	22 "	...
	Kuth Circle . . . . .	...	...	8 acres.
	Kadra "	14 feet	21 feet	11 "
	Sind and Dera Danda	18 to 25 "	28 to 30 "	40 "
Rajanpur	Gharkab	16 "	22 "	14 "

The cost of sinking a masonry well is from Rs. 250 to Rs. 300 in the riverain tract, but it rises to Rs. 400, Rs. 500 and Rs. 600 further inland. A well costing more than Rs. 600 would not pay, because apart from the initial expenditure its depth would make its working costly. In the richer villages of the canal-irrigated tract double-wheeled wells are not uncommon, and a pair of wells are often sunk close together for the irrigation of the same well estate. The area attached to a well of the Danda class is much larger than that of a well estate commanded by a canal, because from half to two-thirds of the area must be left fallow to rest. The Danda wells near the river bank, which are not very deep, can be worked in the hot weather as well as in the cold and a little cotton of good quality is matured with their aid in addition to the wheat crop; further inland the depth of the wells and the great heat in the hot weather prevents their being worked except in the cold weather.

MUZAFFARGARH.

40. The wells in the Muzaffargarh District are of two kinds, those lined with masonry (*pakka kua*) and those lined with logs called *ghat' da kharora*. A well lined with wattles is called *lei da kharora*, because the wattles are made from the *lei* bush. All wells are lined either with

masonry, timber or wattles. The soil is so fine that unlined wells cannot be made. The wells are all worked by the Persian wheel. There were 11,802 wells in 1874-75 of the following depth to the surface of water:—

11,420 wells under 20 feet.

355 wells from 20 to 30 „

27 wells from 30 to 40 „

No wells are deeper than 40 feet. The depth is very uniform, varying only from 9 to 12 feet in the greater part of the district. The depth is least in the south of the district and on the banks of the rivers. In the Thal the depth is greatest and averages 24 feet. A well lined with masonry costs from Rs. 225 to Rs. 380, a well lined with timber Rs. 125, a well lined with wattles Rs. 35 to 90, and a jhallar lined with masonry Rs. 50. As a rule, four pairs of bullocks, costing Rs. 80 a pair, are used per well. The gear costs Rs. 40. A well unassisted by other sources of irrigation irrigates 17 acres, a well assisted by anilab 21 acres, and a well assisted by canal 23 acres. If the cultivator be intelligent and hard-working, or if the shareholders are united, a much larger area can be irrigated. There are only 24,632 acres of unassisted well irrigation in the district.

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Statement showing number of wells and the average area of crops matured per well from 1889-90 to 1899-1900.

District and year.		NUMBER OF WELLS IN USE.			Area of crops matured by well irrigation, column 7 of Statement VIII.	AVERAGE AREA OF CROPS MATURED PER WELL IN .	
		Pakka, column 16 of Statement III.	Kachcha, column 17 of Statement III.	Total.		Normal year 1891-92.	Famine year 1899-1900.
Hisar	1889-90	661	149	813	2,860	...	...
	1890-91	629	90	719	3,020	...	...
	1891-92	546	44	630	1,965	3	...
	1892-93	561	31	602	1,073	...	...
	1893-94	549	28	576	1,306	...	...
	1894-95	547	35	582	1,298	...	...
	1895-96	613	117	730	5,103	...	...
	1896-97	823	359	1,182	9,105	...	...
	1897-98	826	241	1,067	3,402	...	...
	1898-99	847	352	1,199	7,160	...	...
	1899-1900	993	434	1,427	8,080	...	6
	Increase or decrease as compared with 1889-90.	+ 329	+ 285	+ 614	+ 6,120	...	...
Rehtak	1889-90	1,702	462	2,164	21,831	...	...
	1890-91	1,843	540	2,393	26,438	...	...
	1891-92	1,831	510	2,341	21,673	11	...
	1892-93	2,010	75	2,115	19,672	...	...
	1893-94	2,082	358	2,440	18,247	...	...
	1894-95	2,130	416	2,546	14,593	...	...
	1895-96	2,177	551	2,728	23,087	...	...
	1896-97	2,521	2,644	5,165	35,435	...	...
	1897-98	2,555	775	3,380	24,713	...	...
	1898-99	2,623	2,001	4,627	30,376	...	...
	1899-1900	2,770	3,597	6,367	31,030	...	5
	Increase or decrease as compared with 1889-90.	+ 1,068	+ 3,135	+ 4,203	+ 9,196	...	...
Gurgaon	1889-90	7,090	2,188	10,168	78,731	...	...
	1890-91	8,037	2,293	10,330	87,301	...	...
	1891-92	8,135	2,212	10,347	82,695	8	...
	1892-93	5,270	2,230	7,500	74,280	...	...
	1893-94	8,216	2,118	10,334	77,468	...	...
	1894-95	8,241	1,880	10,130	60,270	...	...
	1895-96	8,391	3,018	11,430	83,241	...	...
	1896-97	8,555	3,510	12,074	105,010	...	...
	1897-98	8,686	2,675	11,311	83,103	...	...
	1898-99	8,782	4,012	12,824	101,531	...	...
	1899-1900	9,189	7,018	17,107	113,019	...	7
	Increase or decrease as compared with 1889-90.	+ 1,209	+ 5,780	+ 6,939	+ 34,285	...	...

Mr. Sykes. Statement showing number of wells and the average area of crops matured per well from 1889-90 to 1899-1900—continued.

29 Oct. 01.

District and Year.		NUMBER OF WELLS IN USE.			Area of crops matured by well irrigation, column 7 of Statement VIII.	AVERAGE AREA OF CROPS MATURED PER WELL IN	
		Pukka, column 16, of Statement III.	Kachcha, column 17 of Statement III.	Total.		Normal year 1891-92.	Famine year 1899-1900.
Delhi .	1889-90	6,487	840	7,327	75,940	...	...
	1890-91	6,563	813	7,376	77,415	...	...
	1891-92	6,039	619	6,658	61,969	7	...
	1892-93	5,498	492	5,990	51,082	...	...
	1893-94	8,218	523	8,771	63,877	...	...
	1894-95	8,252	462	8,714	19,031	...	...
	1895-96	8,891	639	9,530	69,894	...	...
	1896-97	8,801	1,702	10,503	110,257	...	...
	1897-98	8,955	877	9,832	80,425	...	...
	1898-99	9,218	1,031	10,247	107,071	...	...
	1899-1900	9,516	3,235	12,751	121,237	...	10
	Increase or decrease as compared with 1889-90.	+ 3,029	+ 2,395	+ 5,424	+ 45,817	...	...
Karnal .	1889-90	7,916	439	8,355	108,938	...	...
	1890-91	7,827	358	8,185	90,786	...	...
	1891-92	8,601	366	8,967	85,080	9	...
	1892-93	7,411	107	7,518	74,411	...	...
	1893-94	9,259	164	9,423	74,728	...	...
	1894-95	9,372	146	9,518	26,515	...	...
	1895-96	9,618	210	9,828	93,808	...	...
	1896-97	9,822	460	10,282	133,679	...	...
	1897-98	10,003	291	10,294	101,438	...	...
	1898-99	10,211	317	10,528	125,129	...	...
	1899-1900	10,773	784	11,557	168,662	...	14
	Increase or decrease as compared with 1889-90.	+ 2,857	+ 345	+ 3,202	+ 49,724	...	...
Umballa .	1889-90	2,101	2,405	4,506	26,076	...	...
	1890-91	2,021	2,072	4,093	20,607	...	...
	1891-92	2,143	1,644	3,787	21,416	6	...
	1892-93	2,228	1,507	3,735	16,568	...	...
	1893-94	2,301	1,532	3,833	19,214	...	...
	1894-95	2,374	1,383	3,757	7,431	...	...
	1895-96	2,413	2,107	4,520	19,036	...	...
	1896-97	2,726	4,967	7,693	40,255	...	...
	1897-98	2,745	2,011	4,756	26,626	...	...
	1898-99	2,781	2,117	4,898	28,107	...	...
	1899-1900	3,229	13,690	16,919	61,180	...	4
	Increase or decrease as compared with 1889-90.	+ 1,128	+ 11,285	+ 12,413	+ 35,104	...	...
Kangra .	1889-90 . . . .	...	44	44	17	...	...
	1890-91 . . . .	...	35	35	26	...	...
	1891-92 . . . .	...	...	...	23	...	...
	1892-93 . . . .	...	...	...	...	...	...
	1893-94 . . . .	...	...	...	...	...	...
	1894-95 . . . .	...	...	...	...	...	...
	1895-96	4	41	45	...	...	...
	1896-97	4	40	44	...	...	...
	1897-98	4	51	55	...	...	...
	1898-99	4	51	55	...	...	...
	1899-1900	4	78	82	...	...	...
	Increase or decrease as compared with 1889-90.	+ 4	+ 34	+ 38	+ 17	...	...
Hoshiarpur .	1889-90	3,624	7,360	10,984	41,679	...	...
	1890-91	3,662	6,733	10,395	35,596	...	...
	1891-92	3,877	7,363	11,240	37,317	3	...
	1892-93	4,015	6,803	10,818	22,003	...	...
	1893-94	4,116	5,190	9,306	22,182	...	...
	1894-95	4,770	5,472	10,242	11,196	...	...
	1895-96	4,919	6,433	11,352	39,417	...	...
	1896-97	5,077	9,091	14,168	50,787	...	...
	1897-98	5,237	8,078	13,315	41,860	...	...
	1898-99	5,402	8,096	13,498	41,985	...	...
	1899-1900	5,691	16,413	22,104	83,427	...	4
	Increase or decrease as compared with 1889-90.	+ 2,067	+ 9,053	+ 11,120	+ 41,748	...	...

Statement showing the number of wells and the average area of crops matured per well from 1889-90 to 1899-1900.—continued.

Mr. Sykes.

29 Oct. 01.

District and year.	NUMBER OF WELLS IN USE.			Area of crops matured by well irrigation, column 7 of Statement VIII.	AVERAGE AREA OF CROPS MATURED PER WELL IN	
	Pakka, column 16 of Statement III.	Kachcha, column 17 of Statement III.	Total.		Normal year 1891-92.	Famine year 1899-1900.
Jullundur .	1889-90	22,715	627	23,342	364,237	...
	1890-91	23,163	715	23,878	346,974	...
	1891-92	23,788	575	24,363	348,601	14
	1892-93	24,541	612	25,153	326,858	...
	1893-94	24,703	512	25,215	326,171	...
	1894-95	24,915	433	25,348	280,826	...
	1895-96	25,107	472	25,579	375,009	...
	1896-97	25,187	659	25,846	397,221	...
	1897-98	26,010	574	26,584	392,887	...
	1898-99	26,350	589	26,939	388,316	...
	1899-1900	26,867	1,119	27,986	410,626	15
	Increase or decrease as compared with 1889-90.	+ 4,152	+ 792	+ 4,974	+ 45,389	...
Ludhiana .	1889-90	8,268	553	8,811	166,645	...
	1890-91	8,118	547	8,665	162,136	...
	1891-92	8,539	470	9,009	161,665	18
	1892-93	8,938	498	9,436	123,120	...
	1893-94	9,058	457	9,515	158,284	...
	1894-95	9,136	455	9,591	109,261	...
	1895-96	9,201	515	9,716	165,851	...
	1896-97	9,293	538	9,831	183,512	...
	1897-98	9,399	517	9,916	174,415	...
	1898-99	9,672	597	10,269	180,190	...
	1899-1900	9,924	1,536	11,460	200,273	17
	Increase or decrease as compared with 1889-90.	+ 1,656	+ 983	+ 2,639	+ 33,628	...
Ferozepore .	1889-90	5,275	668	5,943	110,693	...
	1890-91	5,631	670	6,301	123,114	...
	1891-92	5,895	677	6,572	130,054	20
	1892-93	5,951	503	6,454	85,938	...
	1893-94	6,313	406	6,719	97,184	...
	1894-95	5,452	257	5,709	95,220	...
	1895-96	6,683	386	7,069	139,059	...
	1896-97	7,118	687	7,805	152,792	...
	1897-98	7,416	675	8,091	146,906	...
	1898-99	7,681	697	8,378	149,674	...
	1899-1900	8,066	1,252	9,318	188,570	20
	Increase or decrease as compared with 1889-90.	+ 2,791	+ 584	+ 3,375	+ 77,877	...
Mooltan .	1889-90	15,351	4,925	20,276	120,387	...
	1890-91	15,161	4,783	19,944	124,226	...
	1891-92	17,800	4,661	22,461	105,314	6
	1892-93	18,288	4,723	23,011	104,943	...
	1893-94	18,494	4,196	22,690	102,016	...
	1894-95	18,640	3,914	22,554	110,538	...
	1895-96	18,813	3,901	22,714	130,731	...
	1896-97	19,210	3,772	22,982	138,878	...
	1897-98	19,170	3,870	23,040	107,920	...
	1898-99	19,721	3,870	23,591	123,638	...
	1899-1900	19,950	4,194	24,144	161,361	8
	Increase or decrease as compared with 1889-90.	+ 4,599	+ 731	+ 5,330	+ 40,974	...
Jhang .	1889-90	13,133	220	13,353	272,003	...
	1890-91	13,077	175	13,252	290,257	...
	1891-92	14,721	166	14,887	274,559	18
	1892-93	15,550	189	15,739	282,638	...
	1893-94	15,819	134	15,953	287,440	...
	1894-95	15,922	107	16,029	266,061	...
	1895-96	15,912	191	16,103	266,604	...
	1896-97	15,940	288	16,228	256,024	...
	1897-98	15,971	372	16,343	260,810	...
	1898-99	16,115	281	16,396	212,549	...
	1899-1900	16,235	452	16,687	195,553	12
	Increase or decrease as compared with 1889-90.	+ 2,602	+ 223	+ 2,825	+ 23,550	...

Mr. Sykes. Statement showing number of wells and the average area of crops matured per well from 1889-90 to 1899-1900—continued.

29 Oct. 01.

District and Year.		NUMBER OF WELLS IN USE.			Area of crops matured by well irrigation, column 7 of Statement VIII.	AVERAGE AREA OF CROPS MATURED PER WELL IN	
		Pakka, column 16 of Statement III.	Katcha, column 17 of Statement III.	Total.		Normal year 1891-92.	Famine year 1899-1900.
Montgomery	1889-90	8,777	1,420	10,197	179,819	...	...
	1890-91	9,212	1,063	10,305	209,799	...	...
	1891-92	10,056	1,241	11,297	169,302	16	...
	1892-93	9,501	1,221	10,812	162,117	...	...
	1893-94	10,255	957	11,212	163,918	...	...
	1894-95	10,138	978	11,116	149,585	...	...
	1895-96	10,379	1,170	11,549	170,673	...	...
	1896-97	10,898	1,456	12,354	169,186	...	...
	1897-98	10,822	1,618	12,440	164,079	...	...
	1898-99	11,140	1,404	12,544	213,333	...	...
	1899-1900	11,156	1,502	12,658	177,333	...	14
	Increase or decrease as compared with 1889-90.	+ 2,379	+ 82	+ 2,461	- 2,256	...	...
Lahore	1889-90	12,686	2,080	14,766	314,511	...	...
	1890-91	12,813	1,738	14,581	327,396	...	...
	1891-92	13,183	2,140	15,323	279,468	18	...
	1892-93	13,338	2,019	15,378	284,179	...	...
	1893-94	13,290	2,268	15,558	281,452	...	...
	1894-95	13,306	2,040	15,346	276,647	...	...
	1895-96	13,746	1,890	15,636	282,704	...	...
	1896-97	14,011	2,143	16,154	272,532	...	...
	1897-98	14,182	2,368	16,550	305,638	...	...
	1898-99	14,117	2,532	16,679	296,236	...	...
	1899-1900	14,937	2,311	17,278	271,707	...	16
	Increase or decrease as compared with 1889-90.	+ 2,251	+ 231	+ 2,612	- 42,807	...	...
Amritsar	1889-90	10,112	415	10,527	239,206	...	...
	1890-91	10,215	610	10,835	255,712	...	...
	1891-92	10,457	441	10,898	266,382	24	...
	1892-93	10,558	351	10,909	184,851	...	...
	1893-94	10,627	370	10,997	204,472	...	...
	1894-95	10,190	382	10,572	159,616	...	...
	1895-96	10,953	358	11,359	266,455	...	...
	1896-97	11,118	435	11,553	292,650	...	...
	1897-98	11,267	418	11,685	276,173	...	...
	1898-99	11,407	391	11,801	277,368	...	...
	1899-1900	11,781	413	12,144	308,111	...	25
	Increase or decrease as compared with 1889-90.	+ 1,669	- 2	+ 1,617	+ 18,905	...	...
Gurdaspur	1889-90	5,417	3,229	8,646	139,912	...	...
	1890-91	5,417	2,850	8,297	113,237	...	...
	1891-92	5,556	3,028	8,594	124,637	16	...
	1892-93	5,489	3,077	8,566	77,228	...	...
	1893-94	5,599	2,559	8,457	66,590	...	...
	1894-95	5,627	2,661	8,291	59,746	...	...
	1895-96	5,704	2,745	8,449	129,172	...	...
	1896-97	5,968	3,378	9,246	141,135	...	...
	1897-98	5,947	3,343	9,280	136,704	...	...
	1898-99	6,151	3,547	9,698	121,590	...	...
	1899-1900	6,322	4,001	10,323	168,680	...	15
	Increase or decrease as compared with 1889-90.	+ 1,505	+ 775	+ 2,280	+ 28,668	...	...
Bialkot	1889-90	19,410	2,029	21,439	501,471	...	...
	1890-91	19,314	1,913	21,291	483,472	...	...
	1891-92	20,265	1,960	22,215	481,674	21	...
	1892-93	20,633	1,790	22,425	414,125	...	...
	1893-94	20,823	1,623	22,076	381,214	...	...
	1894-95	20,856	1,536	22,492	356,273	...	...
	1895-96	20,945	1,520	22,465	431,033	...	...
	1896-97	21,313	1,621	22,934	478,661	...	...
	1897-98	21,603	1,657	23,460	518,895	...	...
	1898-99	22,213	1,836	24,049	459,001	...	...
	1899-1900	23,133	1,979	25,106	475,137	...	19
	Increase or decrease as compared with 1889-90.	+ 3,723	- 65	+ 3,658	+ 23,664	...	...

Statement showing number of wells and the average area of crops matured per well from 1889-90 to 1899-1900—continued.

Mr. Sykes.
29 Oct. 01.

District and year.	NUMBER OF WELLS IN USE.			Area of crops matured by well irrigation, column 7 of Statement VIII.	AVERAGE AREA OF CROPS MATURED PER WELL IN	
	Pukka, column 16 of Statement III.	Kacheha, column 17 of Statement III.	Total.		Normal year 1891-92.	Famine year 1899-1900.
Gujrat .	1889-90	8,610	662	9,272	211,831	...
	1890-91	8,175	351	8,526	168,156	...
	1891-92	8,697	809	9,506	182,327	20
	1892-93	8,735	260	8,995	200,117	...
	1893-94	8,719	241	8,960	173,780	...
	1894-95	8,760	338	9,098	175,207	...
	1895-96	8,783	521	9,307	183,420	...
	1896-97	9,007	606	9,613	181,128	...
	1897-98	9,187	609	9,796	208,312	...
	1898-99	9,297	617	9,911	189,469	...
	1899-1900	9,867	1,082	10,979	193,490	18
	Increase or decrease as compared with 1889-90.	+ 1,257	+ 320	+ 1,777	- 18,311	...
Gujranwala .	1889-90	12,149	116	12,261	306,730	...
	1890-91	12,127	136	12,263	333,290	...
	1891-92	12,232	113	12,345	342,816	28
	1892-93	12,301	167	12,461	358,886	...
	1893-94	12,248	92	12,310	357,946	...
	1894-95	12,226	132	12,358	358,034	...
	1895-96	12,218	141	12,362	330,671	...
	1896-97	12,286	137	12,423	326,438	...
	1897-98	12,383	225	12,608	359,200	...
	1898-99	12,475	223	12,698	313,178	...
	1899-1900	12,518	260	12,717	287,024	22
	Increase or decrease as compared with 1889-90.	+ 369	+ 154	+ 553	- 109,116	...
Shahpur .	1889-90	6,534	357	6,891	171,150	...
	1890-91	6,611	312	6,913	186,679	...
	1891-92	6,674	273	6,947	156,848	22
	1892-93	6,665	197	6,865	172,086	...
	1893-94	6,709	141	6,853	174,430	...
	1894-95	6,810	116	6,926	172,817	...
	1895-96	6,973	166	7,129	165,209	...
	1896-97	7,133	198	7,331	158,417	...
	1897-98	7,277	180	7,437	177,720	...
	1898-99	7,382	212	7,594	160,542	...
	1899-1900	7,189	279	7,708	145,819	19
	Increase or decrease as compared with 1889-90.	+ 655	- 78	+ 877	- 25,810	...
Jhelum .	1889-90	4,520	491	4,921	39,332	...
	1890-91	4,416	420	4,835	36,875	...
	1891-92	4,609	414	5,013	39,172	8
	1892-93	4,576	360	4,938	40,303	...
	1893-94	4,561	297	4,858	39,748	...
	1894-95	4,532	210	4,742	37,958	...
	1895-96	4,677	311	4,988	39,169	...
	1896-97	4,626	323	4,952	37,428	...
	1897-98	4,616	311	4,927	36,487	...
	1898-99	4,633	293	4,926	36,787	...
	1899-1900	4,740	283	5,123	37,772	7
	Increase or decrease as compared with 1889-90.	+ 220	- 18	+ 202	- 1,560	...
Rawalpindi .	1889-90	5,416	326	5,742	38,806	...
	1890-91	5,415	970	6,385	37,806	...
	1891-92	5,481	972	6,453	39,371	0
	1892-93	5,530	816	6,346	40,934	...
	1893-94	5,650	825	6,475	39,887	...
	1894-95	5,708	825	6,533	39,411	...
	1895-96	5,791	800	6,591	39,860	...
	1896-97	5,910	820	6,730	43,068	...
	1897-98	6,081	974	7,055	46,094	...
	1898-99	6,169	866	7,035	41,681	...
	1899-1900	6,293	896	7,189	45,013	6
	Increase or decrease as compared with 1889-90.	+ 877	- 30	+ 847	+ 6,177	...

Mr. Sykes. Statement showing number of wells and the average area of crops matured per well from 1889-90 to 1899-1900—continued.

29 Oct. 01.

District and year.	NUMBER OF WELLS IN USE.			Area of crops matured by well irrigation column 7 of Statement VIII.	AVERAGE AREA OF CROPS MATURED PER WELL IN	
	Palka, column 16 of Statement III.	Kachcha, column 17 of Statement III.	Total.		Normal year 1891-92.	Famine year 1899-1900.
Hazara	1889-90	219	45	264	1,256	...
	1890-91	220	61	281	1,124	...
	1891-92	218	62	270	1,181	...
	1892-93	214	68	280	1,317	4
	1893-94	202	65	267	1,268	...
	1894-95	217	61	281	1,325	...
	1895-96	210	70	289	1,368	...
	1896-97	225	73	297	1,569	...
	1897-98	232	70	302	1,699	...
	1898-99	234	77	316	1,658	...
	1899-1900	262	78	330	1,670	...
	Increase or decrease as compared with 1889-90.	+ 33	+ 33	+ 66	+414	6
				
Peshawar	1889-90	4,851	5,179	10,030	52,595	...
	1890-91	4,935	5,241	10,176	51,528	...
	1891-92	4,931	5,678	10,609	51,672	8
	1892-93	5,664	5,162	10,716	70,021	...
	1893-94	5,750	4,823	10,573	80,849	...
	1894-95	9,916*	912	10,828	75,091	...
	1895-96	9,916	958	10,874	71,713	...
	1896-97	10,065	955	11,020	73,718	...
	1897-98	10,198	950	11,148	77,030	...
	1898-99	9,069	1,000	10,069	77,043	...
	1899-1900	10,235	1,101	11,336	76,673	7
	Increase or decrease as compared with 1889-90.	+5,384	-1,078	+ 1,306	-6,022	...
				
Kohat	1889-90	359	205	564	1,873	...
	1890-91	367	202	569	1,877	...
	1891-92	381	193	574	1,871	3
	1892-93	385	192	570	1,936	...
	1893-94	361	216	577	2,307	...
	1894-95	350	208	558	2,003	...
	1895-96	329	197	526	1,752	...
	1896-97	341	195	536	1,842	...
	1897-98	369	172	541	1,558	...
	1898-99	381	178	559	1,719	...
	1899-1900	384	163	549	1,860	3
	Increase or decrease as compared with 1889-90.	+ 27	- 42	- 15	-13	...
				
Bannu	1889-90	628	37	665	3,223	...
	1890-91	466	34	500	3,153	...
	1891-92	441	29	470	3,632	8
	1892-93	460	18	468	3,423	...
	1893-94	412	29	442	3,619	...
	1894-95	411	17	428	3,498	...
	1895-96	477	16	493	3,613	...
	1896-97	491	14	505	3,828	...
	1897-98	470	18	491	3,606	...
	1898-99	490	19	509	3,720	...
	1899-1900	541	26	567	4,152	...
	Increase or decrease as compared with 1889-90.	+3	- 11	- 8	+1,224	6
				
Dera Ismail Khan.	1889-90	5,325	841	6,166	92,824	...
	1890-91	5,358	851	6,213	102,201	...
	1891-92	5,189	892	6,081	107,033	17
	1892-93	5,759	810	6,569	104,461	...
	1893-94	5,891	805	6,696	101,558	...
	1894-95	6,062	744	6,746	103,007	...
	1895-96	6,206	824	7,030	105,837	...
	1896-97	6,331	833	7,164	110,128	...
	1897-98	6,416	799	7,216	108,526	...
	1898-99	6,686	790	7,476	107,031	...
	1899-1900	6,909	867	7,765	111,144	...
	Increase or decrease as compared with 1889-90.	+1,583	+ 10	+1,599	+18,320	14
				

* Increase in wells due to corrections made at settlement, chiefly in classification of *palka* and *kachcha* wells.

Statement showing number of wells and the average area of crops matured per well from 1889-90 to 1899-1900—concluded.

Mr. Sykes.

29 Oct. 01.

District and year.	NUMBER OF WELLS IN USE.			Area of crops matured by well irrigation, column 7 of Statement VIII.	AVERAGE AREA OF CROPS MATURED PER WELL IN		
	Pakka, column 16 of Statement III.	Kacheha, column 17 of Statement III.	Total.		Normal year 1891-92.	Famine year 1899-1900.	
Dera Ghazi Khan.	1889-90	7,204	1,622	8,826	48,574	...	...
	1890-91	7,431	1,817	9,248	52,022	...	...
	1891-92	8,320	1,609	9,929	49,391	5	...
	1892-93	8,763	1,695	10,358	50,871	...	...
	1893-94	8,797	1,475	10,272	56,934	...	...
	1894-95	8,690	1,495	10,191	42,270	...	...
	1895-96	9,097	1,857	10,954	50,961	...	...
	1896-97	9,076	2,059	11,135	49,005	...	...
	1897-98	9,153	1,841	10,997	41,472	...	...
	1898-99	9,393	1,825	11,118	49,102	...	...
	1899-1900	9,390	2,071	11,461	47,297	...	4
	Increase or decrease as compared with 1889-90	+2,186	+449	+2,635	-1,277	...	...
Muzaffargarh.	1889-90	12,243	2,309	14,552	52,873	...	...
	1890-91	12,407	2,365	14,772	59,467	...	...
	1891-92	13,601	2,371	15,972	52,308	3	...
	1892-93	13,885	2,145	16,030	52,107	...	...
	1893-94	11,259	1,744	13,003	54,608	...	...
	1894-95	14,431	1,818	16,253	52,460	...	...
	1895-96	14,583	1,049	15,632	52,260	...	...
	1896-97	14,683	2,036	16,718	50,001	...	...
	1897-98	14,739	2,070	16,815	48,409	...	...
	1898-99	14,757	2,206	16,963	45,583	...	...
	1899-1900	15,024	2,111	17,135	46,509	...	3
	Increase or decrease as compared with 1889-90	+2,781	+102	+2,883	-6,804	...	...
Grand Total of the Punjab.	1889-90	219,940	42,660	262,600	3,059,427	...	...
	1890-91	222,217	40,716	262,933	3,823,323	...	...
	1891-92	232,641	40,251	272,898	3,696,883	14	...
	1892-93	232,768	38,150	270,924	3,428,768	...	...
	1893-94	243,377	35,561	278,938	3,449,672	...	...
	1894-95	248,385	29,478	277,863	3,072,220	...	...
	1895-96	253,137	34,113	287,250	3,730,769	...	...
	1896-97	258,852	46,697	305,549	4,006,984	...	...
	1897-98	262,358	39,288	301,646	3,070,518	...	...
	1898-99	266,510	42,357	308,867	3,966,002	...	...
	1899-1900	274,851	73,869	348,710	4,154,698	...	12
	Increase or decrease as compared with 1889-90	+54,911	+31,199	+86,110	+195,171	...	...

Statement showing total area irrigated by wells, etc., and the average area irrigated per well from 1890-91 to 1899-1900.

Year..	District.	TOTAL AREA IRRIGATED BY				Number of wells, kacheha and pakka.	Average area irrigated by each well.
		Chahi.	Chahi Nahri.	Chahi Sainab.	Total		
1890-91	Hissar.	2,110	...	...	2,110	719	3
1891-92		2,013	...	...	2,013	630	3
1892-93		1,910	...	...	1,910	692	4
1893-94		1,806	...	...	1,806	576	3
1894-95		1,800	...	...	1,800	582	3
1895-96		2,261	...	...	2,261	730	3
1896-97		3,045	...	...	3,045	1,182	3
1897-98		2,370	...	...	2,370	1,067	2
1898-99		3,365	...	...	3,365	1,199	3
1899-1900		3,764	...	...	3,764	1,427	3

Mr. Sykes. Statement showing total area irrigated by wells, etc., and the average area irrigated per well from 1890-91 to 1899-1900.--continued.

29 Oct. 01.

Year.	District.	TOTAL AREA IRRIGATED BY				Number of wells kachcha and pakka.	Average area irrigated by each well.
		Chahi.	Chahi Nabri.	Chahi Sailab.	Total.		
1890-91	Rohilk.	32,165	...	...	32,165	2,358	14
1891-92		36,496	78	...	36,574	2,344	16
1892-93		37,339	91	...	37,430	2,115	18
1893-94		36,987	96	...	37,083	2,410	15
1894-95		37,714	297	...	37,811	2,516	15
1895-96		35,919	115	...	36,034	2,728	14
1896-97		33,323	381	...	33,704	5,165	7
1897-98		39,461	272	...	39,733	3,330	12
1898-99		33,855	208	...	34,063	4,627	7
1899-1900		29,621	175	...	30,796	6,367	4
1890-91	Gurgaon.	99,653	...	...	99,653	10,330	10
1891-92		121,154	...	...	121,154	10,347	12
1892-93		126,806	...	...	126,806	7,500	17
1893-94		128,196	...	...	128,196	10,331	12
1894-95		127,330	...	...	127,330	10,130	12
1895-96		122,365	...	...	122,365	11,439	11
1896-97		116,180	...	...	116,180	12,074	10
1897-98		130,582	...	...	130,582	11,311	12
1898-99		121,718	...	...	121,718	12,821	10
1899-1900		81,701	...	...	81,701	17,107	6
1890-91	Delhi.	76,695	...	...	76,695	7,376	11
1891-92		82,470	...	...	82,470	4,058	10
1892-93		85,528	...	...	85,528	6,960	16
1893-94		85,523	518	...	85,741	8,571	10
1894-95		81,473	1,303	...	85,776	8,514	10
1895-96		83,227	234	...	83,511	9,030	9
1896-97		59,423	599	...	60,292	10,506	8
1897-98		87,866	420	...	88,356	9,832	9
1898-99		88,884	477	...	88,865	10,247	9
1899-1900		78,816	687	...	79,543	12,781	6
1890-91	Karnal.	122,483	...	...	122,483	8,160	15
1891-92		127,914	...	...	127,914	8,909	14
1892-93		130,516	...	...	130,516	7,608	17
1893-94		130,127	...	...	130,427	9,113	14
1894-95		129,561	...	...	129,561	9,518	14
1895-96		117,716	...	...	117,716	9,728	12
1896-97		104,916	...	...	104,916	10,322	11
1897-98		128,682	9	...	128,691	10,281	13
1898-99		124,016	55	...	124,374	10,561	12
1899-1900		109,187	31	...	109,221	11,559	9
1890-91	Unhalla.	20,657	...	...	20,657	4,096	5
1891-92		20,978	...	...	20,978	3,767	6
1892-93		21,672	...	...	21,672	3,735	6
1893-94		21,915	...	...	21,615	3,836	6
1894-95		21,488	...	...	21,488	3,757	6
1895-96		21,206	...	...	21,206	4,550	5
1896-97		21,725	...	...	21,725	7,693	3
1897-98		22,806	...	...	22,806	5,889	4
1898-99		23,866	...	...	23,866	5,201	5
1899-1900		21,131	...	...	21,131	16,029	1
1890-91	Kangra.	19	...	...	19	36	...
1891-92		22	...	...	22	...	...
1892-93		...	...	...	...	...	...
1893-94		...	...	...	...	...	...
1894-95		...	...	...	...	...	...
1895-96		...	...	...	...	48	...
1896-97		...	...	...	...	63	...
1897-98		...	...	...	...	65	...
1898-99		...	...	...	...	65	...
1899-1900		...	...	...	...	82	...
1890-91	Hoshiarpur.	21,416	...	...	21,416	10,395	2
1891-92		26,953	...	...	26,953	11,210	2
1892-93		27,143	...	...	27,143	10,848	3
1893-94		27,748	...	...	27,748	9,306	3
1894-95		27,256	...	...	27,256	10,218	3
1895-96		27,365	...	...	27,365	11,382	2
1896-97		27,697	...	...	27,697	15,068	2
1897-98		28,419	...	...	28,419	12,815	2
1898-99		30,051	...	...	30,051	13,498	2
1899-1900		31,785	...	...	31,785	21,103	2

Statement showing total area irrigated by wells, etc., and the average area irrigated per well from Mr. Sykes.
1890-91 to 1899-1900.—(continued.)

29 Oct 01.

Year.	District.	TOTAL AREA IRRIGATED BY				Number of wells kachra and pakka.	Average area irrigated by each well.
		Chahi.	Chahi Nabri.	Chahi. Sailab.	Total.		
1890-91	Jullundur.	263,302	...	...	263,302	23,878	11
1891-92		269,401	...	...	269,401	21,363	11
1892-93		278,221	...	...	278,221	25,153	11
1893-94		282,143	...	...	282,143	25,215	11
1894-95		278,160	...	...	278,160	25,318	11
1895-96		276,497	...	...	276,497	25,579	11
1896-97		279,440	...	...	279,440	26,176	11
1897-98		286,100	...	...	286,609	26,581	11
1898-99		287,305	...	...	287,395	26,930	11
1899-1900		271,157	...	...	271,157	28,316	10
1890-91	Ludhiana.	114,596	1,201	...	115,797	8,995	13
1891-92		116,691	274	...	116,968	9,009	12
1892-93		121,210	555	...	122,095	9,486	13
1893-94		121,207	1,222	...	123,129	9,545	13
1894-95		122,249	1,313	...	123,602	9,621	13
1895-96		121,256	600	...	121,856	9,718	13
1896-97		121,369	133	...	122,302	9,831	13
1897-98		124,023	985	...	125,908	9,946	13
1898-99		127,913	2,026	...	129,989	10,269	13
1899-1900		120,191	952	...	121,143	11,460	11
1890-91	Ferozepore.	91,054	22,297	...	116,351	6,201	10
1891-92		86,401	20,274	...	106,675	6,472	17
1892-93		90,384	22,180	...	118,564	6,454	19
1893-94		95,118	19,792	...	114,905	6,719	18
1894-95		93,113	18,296	...	111,439	5,703	20
1895-96		81,894	15,364	...	100,258	7,069	14
1896-97		79,391	15,283	...	94,679	7,805	12
1897-98		94,482	22,013	...	116,495	8,091	14
1898-99		103,323	21,743	...	118,068	8,328	14
1899-1900		90,756	29,745	...	120,501	9,318	13
1890-91	Mooltan.	117,869	241,938	...	359,827	19,914	18
1891-92		98,625	263,493	...	368,123	22,464	16
1892-93		100,949	239,293	...	340,292	23,011	16
1893-94		98,538	210,522	...	309,060	22,994	14
1894-95		101,030	181,727	...	285,826	22,551	13
1895-96		122,647	179,369	...	293,506	22,754	13
1896-97		127,653	163,200	...	290,853	22,982	13
1897-98		38,614	304,010	32,031	431,658	23,349	19
1898-99		25,900	328,994	20,822	384,716	23,591	16
1899-1900		10,091	293,189	29,433	312,612	24,144	14
1890-91	Jhang.	258,010	413	...	258,423	13,552	19
1891-92		230,083	920	...	231,003	14,887	16
1892-93		249,163	458	...	249,620	15,739	16
1893-94		257,075	...	...	257,075	15,963	16
1894-95		232,012	...	...	232,012	15,029	14
1895-96		230,776	...	...	230,776	16,103	14
1896-97		220,131	7,293	...	227,424	16,228	14
1897-98		235,728	410	...	236,138	16,313	14
1898-99		208,390	178	...	208,568	16,309	13
1899-1900		165,195	737	...	165,932	16,087	10
1890-91	Montgomery.	192,219	39,617	...	231,896	10,305	13
1891-92		158,862	50,227	...	218,109	11,297	19
1892-93		140,723	62,809	...	193,537	10,812	19
1893-94		156,205	39,500	...	195,711	11,212	17
1894-95		138,780	56,703	...	195,489	11,416	17
1895-96		153,588	39,598	...	193,186	11,519	17
1896-97		154,563	42,450	...	197,013	12,314	16
1897-98		149,551	63,502	...	213,153	12,410	17
1898-99		147,598	40,727	...	107,323	12,544	16
1899-1900		132,251	29,551	902	162,707	12,658	13
1890-91	Lahore.	301,702	13,506	11,137	325,345	14,581	22
1891-92		245,305	11,235	7,023	263,563	15,323	17
1892-93		311,104	15,691	10,907	337,702	15,378	22
1893-94		312,362	17,519	14,199	344,080	15,553	22
1894-95		290,127	16,397	14,725	321,250	15,438	21
1895-96		224,616	13,915	10,930	249,461	15,636	16
1896-97		213,690	14,863	9,742	238,295	16,151	15
1897-98		274,949	20,916	13,817	309,742	16,450	19
1898-99		240,611	19,550	10,496	270,657	16,979	16
1899-1900		201,891	19,622	4,993	226,506	17,278	13

INDIAN IRRIGATION COMMISSION.

Mr. Sykes. Statement showing total area irrigated by wells, etc., and the average area irrigated per well from 1890-1891 to 1899-1900—continued.

29 Oct. 01.

YEAR.	District.	TOTAL AREA IRRIGATED BY				Number of wells kachra and pakka.	Average area irrigated by each well.
		Chahi.	Chahi Nahri.	Chahi Sailab.	Total.		
1890-91	Amritsar.	237,011	2	...	237,013	10,835	23
1891-92		220,258	...	...	220,258	10,803	20
1892-93		238,458	...	...	238,458	10,900	22
1893-94		230,830	...	...	230,830	10,987	22
1894-95		225,761	...	...	225,761	10,572	21
1895-96		210,851	...	...	210,851	11,350	21
1896-97		220,957	...	...	220,957	11,553	19
1897-98		227,470	...	...	227,470	11,685	19
1898-99		220,075	...	...	220,075	11,501	19
1899-1900		218,810	...	...	218,810	12,144	17
1890-91	Gurda-par.	125,085	271	...	125,356	8,297	15
1891-92		125,049	248	...	125,297	8,591	14
1892-93		125,624	421	...	125,045	8,506	15
1893-94		126,431	302	...	126,733	8,457	15
1894-95		122,918	211	...	123,129	8,291	15
1895-96		123,285	266	...	123,551	8,449	15
1896-97		125,658	308	...	125,966	8,246	14
1897-98		123,848	60	...	123,908	8,280	14
1898-99		130,099	78	...	130,177	9,698	14
1899-1900		123,763	60	...	123,823	10,926	12
1890-91	Sialkot.	457,014	...	...	457,014	21,201	21
1891-92		431,709	...	...	431,709	22,225	19
1892-93		441,255	...	...	441,255	22,125	20
1893-94		444,822	...	7,457	452,279	22,476	20
1894-95		408,862	...	8,625	417,487	22,392	19
1895-96		403,619	...	7,836	411,455	22,465	19
1896-97		396,088	...	6,104	402,192	22,931	18
1897-98		425,853	...	7,050	432,903	23,460	18
1898-99		413,903	...	8,166	422,069	24,049	19
1899-1900		316,610	...	4,245	320,855	25,106	14
1890-91	Gujrat.	198,170	...	...	198,170	8,626	24
1891-92		147,116	...	...	147,116	9,006	16
1892-93		191,867	...	...	191,867	9,015	21
1893-94		199,710	...	...	199,710	8,960	24
1894-95		163,244	...	...	163,244	9,088	21
1895-96		147,821	...	...	147,821	9,307	18
1896-97		175,903	...	...	175,903	9,613	16
1897-98		173,478	...	...	173,478	9,796	18
1898-99		130,310	...	...	130,310	9,914	18
1899-1900		...	...	...	...	10,970	13
1890-91	Gujranwala.	412,868	...	...	412,868	13,263	31
1891-92		332,211	6,472	...	338,683	12,332	27
1892-93		399,316	11,336	...	410,652	12,461	33
1893-94		421,606	15,372	...	436,978	12,349	31
1894-95		391,161	12,232	...	403,393	12,356	33
1895-96		313,332	13,397	...	326,729	12,392	26
1896-97		307,612	14,016	...	321,628	12,423	26
1897-98		347,713	15,044	...	362,757	12,608	28
1898-99		369,852	14,412	...	384,264	12,698	30
1899-1900		263,447	16,113	...	279,560	12,817	22
1890-91	Sialpur.	177,661	...	...	177,661	6,913	26
1891-92		146,372	...	...	146,372	6,947	21
1892-93		170,601	...	...	170,601	6,865	25
1893-94		170,809	...	...	170,809	6,853	26
1894-95		169,014	...	...	169,014	6,926	24
1895-96		156,146	...	...	156,146	7,129	22
1896-97		149,004	...	...	149,004	7,331	20
1897-98		174,772	...	...	174,772	7,437	24
1898-99		157,865	...	...	157,865	7,591	20
1899-1900		131,771	...	...	131,771	7,768	17
1890-91	Jhelum.	29,495	...	...	29,495	5,035	6
1891-92		27,223	...	...	27,223	5,013	5
1892-93		30,942	...	...	30,942	4,986	6
1893-94		30,487	...	...	30,487	4,858	6
1894-95		29,711	...	...	29,711	4,743	6
1895-96		28,103	...	...	28,103	4,888	6
1896-97		25,142	...	...	25,142	4,952	5
1897-98		26,045	...	...	26,045	4,927	5
1898-99		21,857	...	...	21,857	4,926	5
1899-1900		...	23,068	...	23,068	5,123	5

Statement showing total area irrigated by wells, etc., and the average area irrigated per well from Mr. Sykes.
1890-1891 to 1899-1900—continued.

29 Oct. 01.

YEAR.	District.	TOTAL AREA IRRIGATED BY				Number wells of kachha and pakka.	Average area irrigated by each well.
		Chahi.	Chahi Nahri.	Chahi Sailab.	Total.		
1890-91	Rawalpindi.	21,249	...	...	21,249	0,415	3
1891-92		21,395	...	...	21,395	0,456	3
1892-93		21,873	...	...	21,873	0,375	3
1893-94		22,038	...	...	22,038	6,475	3
1894-95		21,002	...	...	21,002	0,533	3
1895-96		22,299	...	...	22,299	0,591	3
1896-97		22,399	...	...	22,399	6,780	3
1897-98		23,350	...	...	23,350	7,035	3
1898-99		23,698	...	...	23,698	7,085	3
1899-1900		23,760	...	...	23,760	7,160	3
1890-91	Hazara.	678	9	...	687	281	2
1891-92		694	...	...	694	270	3
1892-93		700	...	...	700	260	3
1893-94		697	...	...	697	267	3
1894-95		715	...	...	718	281	3
1895-96		726	...	...	726	289	3
1896-97		710	...	...	740	297	3
1897-98		823	...	...	823	302	3
1898-99		812	...	...	812	315	3
1899-1900		865	...	...	868	330	3
1890-91	Faisalpur.	45,167	2	3,500	48,669	10,176	5
1891-92		46,129	...	4,406	50,535	10,060	5
1892-93		43,829	...	4,605	48,434	10,716	5
1893-94		43,739	5,824	...	49,563	10,573	5
1894-95		40,980	4,797	...	45,786	10,858	4
1895-96		41,080	4,512	...	45,592	10,574	4
1896-97		40,894	4,041	3	44,935	11,020	4
1897-98		41,198	4,521	...	45,719	11,148	4
1898-99		40,561	4,988	3	45,549	10,969	4
1899-1900		42,083	4,352	6	46,441	11,396	4
1890-91	Kohat.	1,121	...	...	1,121	569	2
1891-92		1,061	...	...	1,061	574	2
1892-93		1,117	...	...	1,117	581	2
1893-94		1,123	...	...	1,123	577	2
1894-95		1,146	...	...	1,146	567	2
1895-96		1,032	2	...	1,034	526	2
1896-97		1,028	5	...	1,033	536	2
1897-98		1,037	7	...	1,044	541	2
1898-99		998	6	...	999	559	2
1899-1900		1,038	12	...	1,050	549	2
1890-91	Banna.	2,307	...	...	2,307	500	5
1891-92		2,543	...	...	2,543	470	5
1892-93		2,460	49	...	2,509	468	5
1893-94		2,639	49	...	2,688	462	6
1894-95		2,461	47	...	2,511	458	5
1895-96		2,657	49	...	2,606	493	5
1896-97		2,763	49	...	2,812	505	6
1897-98		2,848	...	...	2,848	494	6
1898-99		2,811	61	...	2,872	509	6
1899-1900		3,071	60	...	3,121	567	6
1890-91	Dera Ismail Khan.	96,509	897	...	97,406	6,242	16
1891-92		99,547	61	...	99,608	6,381	16
1892-93		97,298	420	...	97,718	6,569	16
1893-94		95,048	147	...	95,245	6,896	14
1894-95		96,010	169	...	96,209	6,746	14
1895-96		101,174	123	...	101,297	7,030	14
1896-97		102,445	252	...	102,697	7,164	14
1897-98		103,929	374	...	104,303	7,215	14
1898-99		89,444	...	52,183	140,627	7,476	19
1899-1900		40,559	...	56,219	102,778	7,765	13
1890-91	Dera Ghazi Khan.	26,170	144,160	...	170,330	9,248	18
1891-92		25,549	140,781	...	166,330	9,839	17
1892-93		25,536	156,732	...	182,268	10,354	18
1893-94		30,016	122,703	...	152,740	10,272	15
1894-95		23,370	137,962	...	161,332	10,191	16
1895-96		19,010	131,091	5,062	155,163	10,954	14
1896-97		18,422	131,848	5,069	145,339	11,135	13
1897-98		19,945	129,280	6,911	155,673	10,997	14
1898-99		19,609	127,811	5,491	152,911	11,118	14
1899-1900		17,538	128,253	5,045	150,836	11,461	13

Mr. Sykes. Statement showing total area irrigated by wells, etc., and the average area irrigated per well from 1890-91 to 1899-1900—concluded.

2^d Oct. 01.

Year.	District.	TOTAL AREA IRRIGATED BY				Number of wells kachcha and pakka.	Average area irrigated by each well.
		Chahi.	Chahi Nahri.	Chahi Saitab.	Total.		
1890-91	Muzaffargarh.	56,685	123,304	...	180,079	14,772	12
1891-92		50,599	137,387	...	187,986	15,872	12
1892-93		50,366	128,000	...	176,366	16,030	11
1893-94		52,422	117,639	...	170,131	16,003	11
1894-95		51,250	105,332	...	156,582	16,252	10
1895-96		60,898	103,303	...	164,204	16,532	9
1896-97		48,696	102,828	...	151,524	16,718	9
1897-98		47,083	109,258	...	156,341	16,816	9
1898-99		42,798	146,847	...	189,645	16,903	11
1899-1900		12,539	157,789	27,790	198,118	17,435	12

Area of crops harvested per 1,000 of population.

Division.	No.	District.	Total area of crops harvested per 1,000 of popula- tion.*	IRRIGATED BY					Total area of crops irrigated.
				CANALS.		Tanks.	Wells.	Other sources.	
				Govern- ment.	Private.				
Delhi.	1	Hissar	1,040	242	12	1	10	...	265
	2	Rohtak	1,939	243	...	...	54	...	297
	3	Gurgaon	1,122	114	...	...	145	10	209
	4	Delhi	964	162	...	1	214	...	377
	5	Karnal	885	205	6	8	155	...	374
	6	Umballa	901	4	...	6	51	15	76
Jullundur.	7	Hoshiarpur	873	11	12	...	57	7	87
	8	Jullundur	915	...	...	1	502	2	505
	9	Ludhiana	1,191	132	...	1	309	...	412
	10	Ferozepore	1,442	565	107	...	178	...	850
Lahore.	11	Mooltan	1,108	679	17	...	227	12	935
	12	Jhang	815	509	1	...	240	6	756
	13	Montgomery	852	320	13	...	403	15	751
	14	Lahore	1,064	418	...	10	316	17	791
	15	Amritsar	941	308	...	1	310	2	651
	16	Gurdaspur	947	47	33	5	158	...	243
Rawalpindi.	17	Sialkot	848	...	10	...	476	22	508
	18	Gujrat	933	...	...	...	270	...	270
	19	Gujranwala	950	349	...	1	424	...	774
	20	Muzaffargarh	919	103	59	...	345	...	507
	21	Jhelum	1,087	...	2	...	67	2	71
	22	Rawalpindi	1,068	...	19	...	54	...	73
Peshawar.	23	Muzaffargarh	824	...	106	...	3	...	109
	24	Peshawar	1,110	242	256	...	116	9	623
	25	Kohat	1,099	...	...	7	10	191	208
Derajat.	26	Banna	1,534	...	423	...	10	...	433
	27	Dera Ismail Khan	1,285	...	102	...	235	...	337
	28	Dera Ghazi Khan	1,198	430	5	...	119	28	582
	29	Muzaffargarh	1,155	727	...	2	121	34	887

* Rural population according to Census of 1901.

MINUTES OF EVIDENCE.

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Statement showing the number of masonry wells newly made and the number fallen in and disused during the last ten years, i.e., from 1890-91 to 1899-1900. Mr. Sykes.

29, Oct. 01.

Year.	NUMBER OF WELLS.			Year.	District.	NUMBER OF WELLS.	
	District.	Newly made or brought into use.	Fallen in and disused.			Newly made or brought into use.	Fallen in and disused.
1890-91	Hissar.	26	61	1890-91	Delhi.		
1891-92		23	44	1891-92		501	429
1892-93		23	43	1892-93		174	103
1893-94		27	40	1893-94		152	73
1894-95		18	19	1894-95		256	166
1895-96		77	11	1895-96		76	72
1896-97		219	9	1896-97		202	63
1897-98		19	16	1897-98		465	52
1898-99		68	47	1898-99		261	110
1899-1900		172	26	1899-1900		349	91
						413	110
1890-91	Rohtak.	221	80	1890-91	Karnal.		
1891-92		70	79	1891-92		320	408
1892-93		237	31	1892-93		1,039	262
1893-94		41	2	1893-94		679	243
1894-95		54	6	1894-95		221	62
1895-96		52	5	1895-96		142	29
1896-97		316	2	1896-97		210	61
1897-98		40	6	1897-98		459	55
1898-99		77	6	1898-99		135	54
1899-1900		153	9	1899-1900		305	64
						581	50
1890-91	Gurgaon.	116	59	1890-91	Umballa.		
1891-92		260	162	1891-92		90	167
1892-93		130	62	1892-93		150	31
1893-94		83	83	1893-94		114	29
1894-95		133	103	1894-95		115	39
1895-96		167	37	1895-96		92	22
1896-97		191	30	1896-97		87	18
1897-98		113	32	1897-98		327	44
1898-99		183	37	1898-99		50	37
1899-1900		436	29	1899-1900		92	53
						463	18
1890-91	Hoshiarpur.	118	81	1890-91	Ferozepore.		
1891-92		307	92	1891-92		382	38
1892-93		235	67	1892-93		936	96
1893-94		153	82	1893-94		217	161
1894-95		101	115	1894-95		421	103
1895-96		223	80	1895-96		185	163
1896-97		211	53	1896-97		314	55
1897-98		207	47	1897-98		501	66
1898-99		205	40	1898-99		363	65
1899-1900		368	79	1899-1900		273	58
						481	46
1890-91	Jullundur.	536	88	1890-91	Mooltan.		
1891-92		739	114	1891-92		759	949
1892-93		570	96	1892-93		379	165
1893-94		352	190	1893-94		382	123
1894-95		336	123	1894-95		344	148
1895-96		325	133	1895-96		310	168
1896-97		470	90	1896-97		303	150
1897-98		660	137	1897-98		506	149
1898-99		432	92	1898-99		422	229
1899-1900		660	113	1899-1900		347	162
						536	307
1890-91	Ludhiana.	233	73	1890-91	Jhang.		
1891-92		213	122	1891-92		555	312
1892-93		147	35	1892-93		408	290
1893-94		149	29	1893-94		238	176
1894-95		113	35	1894-95		570	301
1895-96		104	39	1895-96		348	245
1896-97		135	43	1896-97		192	202
1897-98		167	61	1897-98		223	195
1898-99		339	60	1898-99		165	134
1899-1900		297	45	1899-1900		235	91
						284	174

Mr. Sykes. Statement showing the number of masonry wells newly made and the number fallen in and disused during the last ten years, i.e., from 1890-91 to 1899-1900—contd.

29 Oct. 01.

Year.	District.	NUMBER OF WELLS.		Year.	District.	NUMBER OF WELLS.	
		Newly made or brought into use.	Fallen in and disused.			Newly made or brought into use.	Fallen in and disused.
1890-91	Montgomery.	672	204	1890-91	Gurdaspur.	53	68
1891-92		423	134	1891-92		142	34
1892-93		349	289	1892-93		143	239
1893-94		838	174	1893-94		130	123
1894-95		215	137	1894-95		87	86
1895-96		289	97	1895-96		159	82
1896-97		224	98	1896-97		242	75
1897-98		135	143	1897-98		173	94
1898-99		303	110	1898-99		272	68
1899-1900		197	62	1899-1900		836	64
1890-91	Lahore.	434	277	1890-91	Sialkot.	501	566
1891-92		578	132	1891-92		1,420	503
1892-93		238	210	1892-93		576	301
1893-94		297	311	1893-94		525	213
1894-95		312	269	1894-95		292	271
1895-96		529	179	1895-96		280	201
1896-97		363	102	1896-97		555	187
1897-98		309	137	1897-98		605	175
1898-99		368	109	1898-99		609	190
1899-1900		594	101	1899-1900		1,154	234
1890-91	Amritsar.	182	72	1890-91	Gujrat.	140	125
1891-92		116	82	1891-92		383	138
1892-93		132	41	1892-93		158	120
1893-94		105	92	1893-94		196	128
1894-95		73	526	1894-95		92	124
1895-96		129	59	1895-96		200	147
1896-97		207	41	1896-97		209	95
1897-98		219	70	1897-98		231	110
1898-99		188	48	1898-99		227	117
1899-1900		367	43	1899-1900		574	122
1890-91	Gujranwala.	64	86	1890-91	Rawalpindi.	102	73
1891-92		203	91	1891-92		121	82
1892-93		190	125	1892-93		213	167
1893-94		46	105	1893-94		199	96
1894-95		116	138	1894-95		142	81
1895-96		157	135	1895-96		154	71
1896-97		130	92	1896-97		170	51
1897-98		189	111	1897-98		244	73
1898-99		165	73	1898-99		167	79
1899-1900		230	157	1899-1900		224	100
1890-91	Sheikhpur.	129	62	1890-91	Huzara.	2	1
1891-92		134	61	1891-92		4	6
1892-93		136	142	1892-93		3	6
1893-94		181	100	1893-94		13	26
1894-95		250	140	1894-95		18	3
1895-96		211	86	1895-96		6	7
1896-97		254	94	1896-97		9	3
1897-98		223	99	1897-98		8	2
1898-99		237	162	1898-99		19	13
1899-1900		266	159	1899-1900		19	5
1890-91	Jhelum.	155	60	1890-91	Peshawar.	233	149
1891-92		89	105	1891-92		144	88
1892-93		114	127	1892-93		609	190
1893-94		104	129	1893-94		310	150
1894-95		111	140	1894-95		303	182
1895-96		119	74	1895-96		24	170
1896-97		132	103	1896-97		256	107
1897-98		110	126	1897-98		197	64
1898-99		55	38	1898-99		257	436
1899-1900		207	100	1899-1900		446	180

Statement showing the number of masonry wells newly made and the number fallen in and disused Mr. Sykes.
during the last ten years, i.e., from 1890-91 to 1899-1900—concluded.

28 Oct. 01.

Year.	District.	NUMBER OF WELLS.		Year.	District.	NUMBER OF WELLS.	
		Newly made or brought into use.	Fallen in and disused.			Newly made or brought into use.	Fallen in and disused.
1890-91 . . .	Kohat.	10	2	1890-91 . . .	Dera Ghazi Khan.	293	66
1891-92 . . .		28	14	1891-92 . . .		970	81
1892-93 . . .		15	7	1892-93 . . .		289	94
1893-94 . . .		3	31	1893-94 . . .		207	173
1894-95 . . .		12	14	1894-95 . . .		201	302
1895-96 . . .		36	9	1895-96 . . .		80	59
1896-97 . . .		23	11	1896-97 . . .		161	182
1897-98 . . .		32	4	1897-98 . . .		222	145
1898-99 . . .		15	3	1898-99 . . .		130	69
1899-1900 . . .		15	10	1899-1900 . . .		178	81
1890-91 . . .	Bannu.	16	87	1890-91 . . .	Munafargah.	422	258
1891-92 . . .		26	61	1891-92 . . .		1,253	164
1892-93 . . .		43	31	1892-93 . . .		565	181
1893-94 . . .		16	24	1893-94 . . .		514	140
1894-95 . . .		22	23	1894-95 . . .		287	112
1895-96 . . .		54	18	1895-96 . . .		230	81
1896-97 . . .		25	11	1896-97 . . .		220	120
1897-98 . . .		16	23	1897-98 . . .		171	115
1898-99 . . .		20	9	1898-99 . . .		216	198
1899-1900 . . .		65	14	1899-1900 . . .		405	133
1890-91 . . .	Dera Ismail Khan.	140	107	1890-91 . . .	Total of the Punjab.	6,579	4,030
1891-92 . . .		199	69	1891-92 . . .		9,767	3,118
1892-93 . . .		255	123	1892-93 . . .		7,227	3,551
1893-94 . . .		185	57	1893-94 . . .		6,614	7,397
1894-95 . . .		160	52	1894-95 . . .		4,110	3,532
1895-96 . . .		258	50	1895-96 . . .		5,251	2,352
1896-97 . . .		193	67	1896-97 . . .		6,890	2,053
1897-98 . . .		103	43	1897-98 . . .		5,418	2,239
1898-99 . . .		322	52	1898-99 . . .		6,002	2,483
1899-1900 . . .		285	63	1899-1900 . . .		10,169	2,369

1. Q. (The President).—You are Director of Land Revenue and Agriculture and all the statistics pass through your hands?—All statistics except those relating to collection of revenue and the distribution of *takari*.

2. Q. So in the course of our wanderings if we want statistics on any subject we should refer to you?—I shall be able to give them. The first statement attached to my memo. shows the number of wells and the average area of crops matured with the aid of well irrigation, both *pakka* and *kachha*. It is based on crop returns of *chahi* crops,

irrespective of the permanent classification of soil areas. The figures shown in this statement also include figures of double cropping. The second statement is headed "Statement showing the total area irrigated by wells, etc., and the average area irrigated per well from 1890-91 to 1899-1900. This statement is based on the returns regarding land permanently classified as well land; and the figures actually shown give the soil area out of such permanent well area, on which matured crops were actually grown in each year, whether actually well irrigated or not in a particular harvest, and without taking double cropping into account.

Mr. Sykes. The soil classification of land roughly speaking is revised quadrennially. It is intended to show the permanent conditions under which agriculture is carried on. And as *kachcha* wells are generally only of a temporary ohometer the statistics in this return cannot be relied on to take account of *kachcha* well irrigation. On the whole therefore I venture to think that the first statement will be found to be of more value than this one.

29 Oct. 01.

The third statement is headed "Area of crops harvested per 1,000 of population." The population was taken from the returns of rural population at the recent census.

The fourth statement shows the number of masonry wells newly made and the number fallen in and disused during the last ten years. The first statement showing the area of crops harvested (including do-fasil), will give information of which is more useful. The last statement shows the number of new wells made and the number fallen in and disused during the past ten years.

3. *Q. (Mr. Wilson).*—Will you explain, please, how we worked up the statistics?—There are two kinds of failed crops—one is when the crops wither entirely, that is, regarded as *kharāba*, then there is an estimate of the *kharāba* when a good deal below the average. The *patwari* estimates what the *kharāba* should be, and makes an area reduction according to his estimate.

4. *Q.* Is he a judge?—No is the judge, but his work is supervised.

5. *Q. (The President).*—As a matter of fact is there a large reduction made on account of *kharāba*?—Yes, in some years.

6. *Q. (Mr. Wilson).*—In column 2—*pakka* wells. Does this mean wells actually used in that year?—It means wells in working order in that year whether actually used or not.

7. *Q.* Does it include those that were not used in that particular year?—Yes.

8. *Q.* Is not the number of wells shown as actually in use in a particular year, too large?—Yes, I think so, because it includes many wells in the irrigating area not used, because land is irrigated by the canal.

9. *Q.* Can you say how many wells are used in a year and how many are not?—I should have to call for that. The average area irrigated by *kachcha* wells is not more than one acre.

10. *Q.* In the case of *kachcha* wells, does the figure include *kachcha* wells not used for that year?—Yes.

11. *Q.* I understand that during the last 11 years the number of *pakka* wells in the Punjab has increased by 64,411?—Yes.

12. *Q.* And the number of *kachcha* wells by 31,000?—The number of *kachcha* wells fluctuates year by year.

13. *Q.* If you examine these figures you will see that the number of *kachcha* wells except last year has not increased at all. Only this year (a dry year) have they increased?—Yes.

14. *Q.* In the case of *pakka* wells there has been a steady increase all through?—Yes.

15. *Q.* What do you estimate the average cost of a well in the Punjab?—I have not made that estimate.

16. *Q.* I estimate Rs. 300?—That would be a fair estimate.

17. *Q.* Then you give the average area cropped in two years 1891-1892 and 1899-1900. Why those two years?—I chose 1891-1892 because the cropped area was a normal one looking at the figures for the period of ten years; and 1899-1900 because it was a famine year.

[*Mr. Sykes* explained this point from a diagram in the Revenue report.]

18. *Q.* According to the total average for the whole of the Punjab, the average area per well was 14 acres?—Last year only 12 acres.

19. *Q.* How is the decrease accounted for?—By the number of *kachcha* wells.

20. *Q.* Apart from the *kachcha* wells, do you expect an ordinary *pakka* well to irrigate more or less than the average in a famine year?—To irrigate more in a famine year.

21. *Q.* Take for instance the Jhang district, in which there are no *kachcha* wells—12 years is the average against 18 for a normal year. In the case of Delhi, the area went up from 7 to 10. In the case of Karnal district, the average

area for a normal year is 9 acres—in a dry year 14 acres?—Ordinarily speaking in a dry year a *pakka* well is worked to the utmost and there is a tendency to spread well irrigation over a large area instead of confining it to valuable crops such as sugarcane and tobacco. The decrease of the average of a dry year in Jhang district is I expect due to the fact that the well area in that district is chiefly confined to the river circle, and the water level sinks in a dry year, so that the wells are not capable of irrigating to the same extent as in a year of good sailah. In Delhi and Karnal the average in the normal year in 1891-93 was large, a fact which may have been due to some change in statistics in that year. We have not separate statistics for *kachcha* wells and the average are therefore affected by the very large increase in the number of *kachcha* wells in use in a dry year; the area irrigated by a *kachcha* well is usually less than one acre.

22. *Q.* There has been during the past 11 years an increase of *pakka* wells in every district in the Punjab?—I think so.

23. *Q. (Mr. Ibbetson).*—Apparently from these figures there is a large general increase in the number of *pakka* wells in the Punjab. Do you think we should do anything to stimulate this increase?—I think so.

24. *Q.* What do you suggest?—We have made an enquiry as to where *kachcha* wells might be made. I am inclined to think an overseer might be appointed to advise whether a locality is favourable for construction of *pakka* wells.

25. *Q.* A Public Works Overseer?—Yes. As regards *takavi*, I should prefer to reduce the limit of the period of protective loans and, instead of that, do away with interest on *takavi* loans to private owners.

26. *Q.*—Would you reduce the period of exemption?—I should reduce the period of exemption.

27. *Q.* Not the period of repayment of loan?—No; I don't think so.

28. *Q. (The President).*—Twenty years is the period of repayment of loan?—Yes, that is the usual period. I would have a register instead of the formal bonds. I was inclined to advise that on well-irrigated land which is also irrigated by canals the occupier's rate should be reduced.

29. *Q. (Mr. Ibbetson).*—What would be the object of reducing the occupier's rate?—I think it is not fair to charge the full rate. A man who employs labour and keeps well-bullocks has much more expense in cultivation.

30. *Q.* Would not that mean that a man would use well-water for half a day and canal water for the rest of the season?—There would be danger from that.

31. *Q.* In that case it would be a direct encouragement to use canal water in part of the year when least needed?—In a country which is irrigated by a canal the subsoil water is raised and many more wells can be constructed in that area at less cost than before.

32. *Q.* I understand your point to be to charge rates that would encourage men to use wells and not use canal water?—To encourage men to use wells.

33. *Q. (The President).*—You think if the difficulties attending the granting of the *takavi* advances procedure were made easier the advances would be more freely taken advantage of?—Yes; I think the object in making the procedure easier would be to stimulate the Deputy Commissioners in impressing the advantage of these advances on the people. Mr. Merck said he would go about with rupees himself. The Accountant General would not, however, like that.

34. *Q.* If we could amend the tenancy laws to give more protection to tenants to spend capital—that would encourage them?—No; I think not. The landlords would be deterred more than anything.

35. *Q.* It would do more harm than good?—I think so.

36. *Q.* What do you think of the scheme of Government constructing wells at its own cost reconing itself by a rate? Do you think the scheme is likely to succeed?—No.

37. *Q.* Why?—I think the revenue arrangements would be very complicated for one thing.

38. *Q.* Do you think Government would do it so cheaply?—No. The expenditure would be considerably greater. There would be friction between landlords and tenants. I am decidedly against it.

39. *Q. (Mr. Rajaratna).*—Do you assess on the area of matured crops?—If there is a 10-acre field and we see that the crop is perhaps a four-anna crop, then we take five and not ten acres as the cropped area.

40. Q. (*Mr. Toleston*).—Allowance is made when it is below eight annas?—Yes.

41. Q. (*Mr. Rajaratna*).—The estimate is made by the *patwaris*. The amount of supervision exercised is practically very little?—Yes, I am afraid it is.

42. Q. How many wells were constructed from State loans?—I have not the figures here.

43. Q.—Is the area of double-cropped land increasing?—
Yes. 29 Oct. 01.

WITNESS 11—*Mr. L. LAVILLE*, Assistant Secretary to the Punjab Government, Financial Department.

Memorandum I. on Land Improvement Loans.

Mr. WILSON, the Settlement Commissioner, Punjab, asked me for notes on the question whether the gain to "Provincial" in the account of interest on "Land Improvement Loans" (Act XIX of 1883) could not be made available for grants of loans of that class free of interest or at a reduced rate of interest.

2. Land Improvement Loans are made from the "Provincial Loan Account," which includes the following other classes of loans, *viz.*—

- Agriculturists' Loans (Act XII of 1884);
- Loans to Municipalities and District Boards;
- Loans to Landholders and *Kotadars*.

Provincial pays interest to Imperial on all these loans collectively, and is charged with all that become irrecoverable; *per contra* Provincial receives in full all the interest realized on the loans. The difference is the Provincial gain or loss.

3. The appended statement shows that there has been during the past 11 years, on the Provincial Loan Account as a whole, an average annual gain to Provincial of Rs. 49,660, of which Rs. 40,000 accrued from Land Improvement Loans. The value of the latter amount in interest-free loans would be about 11½ lakhs. Less than Rs. 1,500 a year had to be written off on account of irrecoverable loans, that is to say, unrealizable *principal*; how much, if any, unrealizable *interest* was also written off, the accounts, for obvious reason, do not show. The experience of the past in these respects is not, however, of much importance; loan risks are not to be measured by such past experience.

4. Existing rules provide for the grant of Land Improvement Loans and Agriculturists' Loans without interest or at a reduced interest in special cases. Loans to Municipalities, District Boards and Landholders now rarely carry a higher rate of interest than 4 per cent., which is only ½ per cent. higher than the rate at which money is borrowed by the Government of India and advanced to Provincial. To the poorer local bodies the grant of loans at even a

lower rate of interest is contemplated. The risks, ordinary and extraordinary, which Government accepts in granting loans are not inconsiderable. The case is perhaps an extreme one, but had Dera Ghazi Khan town been destroyed by the River Indus the other day, as we all expected it would be, a Municipal loan of Rs. 3,40,000 would have become irrecoverable.

5. Accepting the principle that there must be at least no loss on money put out to loan by the State, I do not think that under the conditions above stated the Government can safely undertake to surrender the present surplus of interest on such loans by the grant of interest-free loans on a larger scale than is provided for by existing arrangements.

6. That the Local Government cannot make any such surrender of surplus income from the Provincial Loan Account under the scheme of Provincial services now obtaining will be understood from the circumstance that in that scheme the surplus of the account is included in the allotment of general revenue made to meet the general Provincial expenditure, and is therefore appropriated for other services. Thus—

	Rs.
Contract estimate of Provincial expenditure, excluding interest payable on Loan Account	1,88,24,000
Contract estimate of revenue, excluding interest derived from Loan Account, provincialized to meet expenditure	1,87,58,000
Deficiency of revenue	66,000
Contract estimate of interest derived from Loan Account	2,60,000
Contract estimate of interest payable on Loan Account	1,94,000
Surplus assigned to meet deficiency	66,000

Statement of Net Provincial Revenue from interest on (1) Land Improvement Loans, and (2) all classes of loans (including Land Improvement Loans) in the Provincial Loan and Advance Account.

Year.	LAND IMPROVEMENT LOANS ACT, XIX OF 1883							PROVINCIAL LOAN AND ADVANCE ACCOUNT AS A WHOLE.						
	Balance of advances outstanding at the beginning of the year.	Balance of advances outstanding at the end of the year.	Total.	Mean outstanding balance.	Interest paid by Provincial on the mean balance.	Interest covered by Provincial on the mean balance.	Interest charged to Provincial.	Interest credited to Provincial.	Net credit to Provincial.	Interest paid by Provincial.	Interest covered by Provincial.	Total charged to Provincial.	Interest credited to Provincial.	Net credit to Provincial.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1883-84	13,93,207	11,53,229	25,46,435	14,74,717	54,983	205	67,193	63,051	31,777	1,74,814	285	1,75,019	2,25,504	50,485
1884-85	14,56,229	13,64,911	28,21,140	14,04,070	51,514	391	8,884	1,02,401	43,519	1,68,185	391	1,68,516	2,40,157	53,611
1885-86	14,61,911	15,93,270	30,55,181	15,34,491	61,361	470	8,234	1,14,115	52,531	1,60,882	470	1,61,352	2,73,269	69,917
1886-87	15,93,270	15,65,263	31,58,533	15,81,767	63,270	135	6,405	1,21,263	61,861	1,22,983	135	1,23,118	2,91,853	81,735
1887-88	15,65,263	13,90,410	29,55,673	11,77,836	59,113	2,372	61,185	1,00,391	97,909	1,08,331	2,372	1,10,703	2,74,276	63,573
1888-89	13,90,410	12,93,918	26,84,328	13,42,164	54,011	724	31,410	81,721	30,770	1,15,147	717	1,15,864	2,56,653	68,955
1889-90	12,93,918	13,67,149	26,61,067	13,30,929	53,217	717	30,931	74,159	20,715	1,05,423	130	1,05,553	2,56,653	53,070
1890-91	13,67,149	13,35,717	27,02,866	13,51,640	47,314	130	30,121	84,043	37,829	1,07,768	3,425	1,11,193	2,61,375	50,182
1891-92	13,35,717	13,42,149	26,77,866	13,31,255	46,419	3,425	51,314	75,656	21,312	1,15,054	859	1,15,913	2,45,665	23,652
1892-93	13,42,149	15,86,353	29,28,502	15,41,575	50,335	859	52,837	95,202	36,395	1,54,001	6,093	1,60,094	2,82,411	19,354
1893-94	15,86,353	15,23,195	31,09,548	15,31,774	54,717	6,093	6,10,853	10,58,630	4,38,755			23,05,146	28,45,776	5,40,630

A—Four per cent. till 1896-97 and thereafter 3½ per cent.

1.—The accounts do not state the nature of these advances, but they are assumed to be Takari advances.

Memorandum II (Financial).

STATEMENTS are appended showing for the ten years ending with 1900-01 the accounts of Provincial revenue and expenditure under the heads XXX and 47—Irrigation—Minor Works and Navigation. In addition to the revenue accounted for in this statement Provincial has received under the head 1—Land Revenue the share

assigned to it by the quinquennial financial contracts of all indirect revenue from irrigation works, whether Imperial, Provincial or Local, which is credited to that head. The amount of these receipts cannot readily be stated as they are not shown separately in the accounts. The Provincial share of them under the quinquennial contract now current is two-fifths.

Mr. Laville. 2. The following are the principal works embraced by the statement:—

29 Oct. 01.

- (1) *Kabul River Canal*.—Capital outlay Rs. 4,81,070, Revenue Rs. 6,59,000, maintenance and collection Rs. 2,47,000, net Revenue Rs. 4,12,000 which is equal to about 8·6 per cent. per annum on capital outlay. The revenue is from water-rates and mill rents; the latter amounted to nearly Rs. 29,000 in 1900-01. Irrigation capacity 24,000 acres. Further particulars about the canal and the proposed Hazar Khaur Branch of it will be found in No. XVI-A of the "Notes on Irrigation Works."
- (2) *Shahpur Provincial Inundation Canals*.—The Kaniwah, Corbynwah and Pind Dadan Canals. Revenue Rs. 3,66,000, expenditure Rs. 3,20,000, average net annual revenue Rs. 4,600. The expenditure includes Rs. 15,000 for purchase of the Corbynwah in 1891-92. The revenue is derived practically wholly from occupiers' rates. —No. XIII—Notes on Irrigation Works.
- (3) *Shah Nahr Canal, Hoshiarpur*.—A quasi-private canal managed by Government, who by mutual agreement acquired all the rights of the shareholders. The average net annual revenue and expenditure have been about the same, viz., Rs. 5,8·7 and Rs. 5,034. The local officers, however, question the correctness of these amounts, and claim that there has been a surplus of revenue which they have proposed to lay out on a branch canal. The revenue is derived from a water-rate. —pages 16 and 95, Notes on Irrigation, and Mr. Fagan's Memo.
- (4) *Ferozepore Inundation Canals*.—The expenditure represents contributions to the District Canal Fund for the improvement of the local inundation canals. A similar contribution of Rs. 10,000 was made in 1890-91, the total Provincial contribution being, thus, Rs. 25,000. The District Board contributed an equal amount for the same purpose, and also advanced a sum of Rs. 16,000 for the construction of the Aghwal Canal as a famine relief work. Of this advance the Board has recovered about one-fourth up to date. See Irrigation Department Notes XVI-B, XXX and XXXI.
- (5) *Darbat Ali Khan Canal, Multan*.—This canal was acquired by purchase for Rs. 5,000 from Khan Bahadur Darbat Ali Khan of Lahore who had constructed it. A sum of Rs. 41,000 was spent in endeavouring to improve it, but without success, and it was ultimately abandoned as a failure. It yielded practically no revenue.
- (6) *Hajivah Canal, Multan*.—Originally a private canal. Government assumed the management in 1888. The canal remained on the Provincial list of works till 1891-92, and was then imperilled.
- (7) *Peshawar and Kohat Mirab Cess*.—In connection with the private canals scheduled under the Peshawar Canals Regulation, IV of 1899, an establishment is maintained to regulate the distribution of water and see that the irrigators execute the necessary repairs. For these purposes the area irrigated is divided into circles with an official called a Mirab in charge of each, and a cess on the land revenue is levied for the payment of the establishment.

3. The direct revenue from all canals constructed from the Provincial revenues or from loans raised by the Provincial Government would be credited wholly to Provincial; of the indirect revenue, that is to say, the revenue claimed in the accounts as Land Revenue, Provincial would get only the same share as it got of the Land Revenue under the Provincial settlement for the time being. Provincial would share to the same extent in the indirect revenue of all Imperial and Local canals also.

4. Resolution of the Government of India, in the Finance Department, No. 2009, dated 23rd March 1878, contemplated the construction of canals by Provincial from loans raised by debentures or advanced from the Imperial treasury. It was pointed out by the Finance Committee of 1886, in Section E, Volume II of their report, that works

constructed from such loans involved during construction a heavy charge against Provincial, without any compensating return, on account of interest on the borrowed capital. And with a view to postponing the liability for the interest charges till the work shall have become productive, the Committee suggested the following amended procedure:—

"8. *Proposed Procedure*.—A province, which desires to commence a new irrigation project, would under this proposal submit to the Government of India an estimate of the amount required for capital construction, year by year, and for annual maintenance charges both during construction, and for a period not exceeding ten years from the opening of the irrigation work, after the expiry of which period, according to the estimate, the revenue should be sufficient to meet both maintenance charges and interest on capital. Upon this basis, the Imperial Government would undertake to furnish year by year the money required for capital construction; but would meantime bear all revenue charges including that for interest on capital. At the term fixed (or, at the option of the Provincial Government, at any earlier date) the work would become either partly or wholly Provincial, as the Government of India may decide. This procedure can be applied not only to future new works, but (*mutatis mutandis*) to works which are now under construction and have not yet attained to their full bearing."

"4. *Arrears of interest*.—It seems on the whole advisable that the responsibility for the interest, which accrues during construction and until the taking over of the work, should finally ultimately on the Local Government, and it can hereafter be determined whether these arrears of interest should be treated as a loan (as between Imperial and Provincial) and recovered by annual instalments, or should be added to the capital account of the work."

Every such arrangement, the Finance Committee contemplated, "would be a separate and subsidiary one, not part of the regular Provincial contract; first, because it is obvious that its duration must be fixed on special considerations and may or may not be the same as that of the regular contract; second, because it must be a stipulation that the money allotted under the arrangement is applicable only to the particular purpose defined and cannot be used for any other."

The Committee's scheme has been adopted in the case of two large canals in the Punjab, viz., the Sirsa extension of the Western Jumna Canal and the Jhelum Canal, which may therefore be said to be Provincial works (Proceedings of the Government of the Punjab, Public Works Department, Irrigation, Nos. 2-5 A., July 1884). There seems to be no reason why future projects should not be undertaken on the same lines as Provincial projects.

5. Turning to the case of works constructed direct from the Provincial revenues, whether current or accumulated income, I do not think present arrangements under the Provincial contract need discourage the application of Provincial money to such works. The Provincial contract, simply stated, is an arrangement whereby at certain fixed intervals the present cost of certain services classed as Provincial being ascertained, certain sources of revenue estimated at their present value to be equal to that cost are provincialized to meet it. Thereafter and for the term of the contract the growth of the Provincial expenditure must be met from the growth of the Provincial revenue. In such a system it is sound policy from the Provincial point of view to lay out every rupee by which the revenue increases on necessary permanent expenditure, to leave the revenue in excess of the expenditure to surrender the surplus at the next revision of contract. Assuming that that all growth in the revenue would be utilized to the full as described above, it follows that the net revenue from any new canal or other productive work constructed from the Provincial revenues would be secured to the province by the mere fact of the equivalent increase in the Provincial expenditure.

6. In the current Provincial contract the Punjab Government received a special grant of Rs. 40,000 per annum (Rs. 2,30,000 for the five years) for the construction of new minor irrigation works, but this allotment has had to be diverted to meet plague and famine expenditure.

Statement showing the amounts credited to *PROVINCIAL* under the head 'XXX—Irrigation—Minor Works and Navigation' during the past ten years.

29 Oct. 01.

	1891-92.	1892-93.	1893-94.	1894-95.	1895-96.	1896-97.	1897-98.	1898-99.	1899-00.	1900-01.	Total.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
(1) Kabul River Canal	...	...	19,778	22,883	60,461	84,275	1,14,770	1,14,488	87,102	1,40,318	6,59,478
(2) Shahpur Provincial Inundation Canal	84,030	45,621	23,853	15,461	41,914	34,017	35,073	38,960	41,453	49,517	3,65,939
(3) Shah Nahr Canal, Hoshiarpur	4,850	1,816	8,115	4,826	5,078	7,256	4,530	10,096	6,420	5,338	58,675
(4) Ferozepore Inundation Canals	...	...	...	...	...	...	...	...	...	...	...
(5) Barkat Ali Khan Canal, Mooltan	...	...	...	...	...	165	42	229	...	30	465
(6) Hajivali Canal, Mooltan	21,765	...	...	...	...	...	...	...	...	...	21,765
(7) Peshawar and Kohat Mirab Cess	6,494	6,524	6,619	6,607	6,366	6,500	6,713	6,425	6,430	8,751	67,422
(8) Najafgarh Jhill Drainage	...	...	...	...	...	...	...	...	61	96	157
(9) Rer Escape Drainage Channel, Western Jumna Canal	...	...	...	...	...	...	...	...	...	...	...
(10) Chak Andar Survey, Bari Doab Canal	...	...	...	...	...	...	...	...	...	...	...
(11) Jalalpur Canal	...	...	...	...	...	...	...	...	...	...	...
(12) Rangol	...	...	...	...	...	...	...	...	...	...	...
(13) Bari River—Irrigation Works	...	...	...	...	...	...	...	...	...	...	...
(14) Sarauti Canal Survey	...	...	...	...	...	...	...	...	...	...	...
(15) Survey of Seran River Canal	...	...	...	...	...	...	...	...	...	...	...
(16) Shah Mahal Canal, Beshawar	...	...	...	...	...	...	...	...	...	...	...
(17) Jhang District Survey	...	...	...	...	...	...	...	...	...	...	...
(18) Channab Canal	...	...	...	...	...	...	...	...	...	...	...
(19) Refunds of Canal Receipts	...	...	...	...	...	...	...	...	...	...	...
TOTAL	68,023	54,161	63,343	65,200	1,13,819	1,21,213	1,61,428	1,70,197	1,41,466	2,01,003	11,73,961

Statement of charges adjusted against *PROVINCIAL* under the head '43—Irrigation—Minor Works and Navigation' during the past ten years.

	1891-92.	1892-93.	1893-94.	1894-95.	1895-96.	1896-97.	1897-98.	1898-99.	1899-00.	1900-01.	Total.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
(1) Kabul River Canal	C. 1,57,978	2,19,725	38,727	29,767	137	—460	...	—405	—150	14,891	C. 4,81,230
(2) Shahpur Provincial Inundation Canals	H. ...	...	17,527	23,185	23,257	29,759	21,626	51,628	53,161	35,750	R. 2,47,256
(3) Shah Nahr Canal, Hoshiarpur	28,767	22,514	25,722	35,379	27,563	37,031	33,712	33,701	28,341	31,650	3,20,147
(4) Ferozepore Inundation Canals	4,261	5,052	6,121	8,246	5,921	6,561	6,210	5,515	5,723	5,567	59,315
(5) Barkat Ali Khan Canal, Mooltan	5,000	5,000	5,000	...	...	...	...	...	...	...	15,000
(6) Hajivali Canal, Mooltan	3,755	8,253	11,071	17,993	...	...	...	...	...	...	41,060
(7) Peshawar and Kohat Mirab Cess	12,462	...	...	...	...	...	...	...	...	...	12,462
(8) Najafgarh Jhill Drainage	6,406	7,549	6,656	6,532	6,375	6,814	6,778	6,486	6,000	6,388	66,073
(9) Rer Escape Drainage Channel, Western Jumna Canal	...	...	...	...	...	...	...	...	60	957	1,017
(10) Chak Andar Survey, Bari Doab Canal	2,215	215	316	513	...	...	...	...	...	...	3,293
(11) Jalalpur Canal Survey	...	...	...	...	...	...	47	1,380	...	...	1,427
(12) Rangol Canal Survey	...	...	...	...	...	...	...	...	1,670	...	1,670
(13) Bari River—Irrigation Works	...	...	...	...	...	...	...	...	...	...	...
(14) Sarauti Canal Survey	...	...	...	...	...	...	...	...	...	...	...
(15) Survey of Seran River Canal	...	...	...	...	...	...	...	...	...	...	...
(16) Shah Mahal Canal Survey, Peshawar	...	...	...	...	...	...	...	...	1,462	...	1,462
(17) Jhang District Survey	519	...	...	...	...	...	...	...	...	...	519
(18) Channab Canal	63	71	...	49	42	41	...	...	...	...	266
(19) Refunds of Canal Receipts	...	...	55	...	...	...	...	...	...	...	56
TOTAL	2,21,999	2,59,707	1,24,577	1,21,825	64,291	70,800	63,119	93,661	96,663	1,04,338	12,59,829

1. Q. (The President).—You say in paragraph 4 of your note "the existing rules provide for the grant of Land Improvement Loans and Agriculturists' Loans without interest or at a reduced interest in special cases." These do not apply to *takavi* advances; do they?—Yes, they do; our rules provide for the grant of such loans without interest.

2. Q. Can the Local Government sanction broad cast loans for the construction of wells without interest?—That question has never come before me.

3. Q. We have heard of 6½ per cent. being the rule. You mention 4 per cent. Is it optional with the Local

Government to change the interest and charge less?—I wrote of the 4 per cent. rule in connection with loans to Municipalities, District Boards and Landholders only. But it is optional with the Local Governments to charge less than 6½ per cent. on *takavi* advances in special cases.

Mr. Wilson read to the Commission the rule bearing on the subject and remarked—that means special rules in special cases.

4. Q. (The President).—As a matter of fact it is not availed of in the case of advances for wells?—Not to any great extent.

Mr. LaVie. 5. Q. (*Mr. Higham*).—Under your Provincial Contract the Province gets Rs. 45,000 for expenditure on new provincial works?—Yes.

29 Oct. 01.

6. Q. In addition they get the whole of the direct revenue on existing provincial works?—Not in addition. The direct revenue has been assigned to us wholly; it is Rs. 45,000 in excess of the expenditure on maintaining the works; that Rs. 45,000 is given as a grant for the construction of new works.

7. Q. Practically you get the whole of the direct revenue assigned to you and pay working expenses and have Rs. 45,000 for the construction of new works?—Yes.

8. Q. But you cannot undertake any works at all?—We have not been able to spend the Rs. 45,000 on new works, because we have wanted the money for famine and plague purposes.

9. Q. Have there been any applications for money?—I know one scheme that has been postponed for want of money, that is the Hazarkhani extension of the Kabul river canal. That would probably have been constructed if the Rs. 45,000 had not been required for famine and plague expenditure.

10. Q. If you have money available that you don't want for famine and plague purposes there is nothing in the present arrangement to discourage the Local Governments from allotting it?—No; I think not.

11. Q. Whatever extra revenue they make in consequence, their expenditure might expand in proportion?—Yes; and as in each fresh contract their allotment of revenue would be not less than their expenditure they would recover the net revenue from their new works.

12. Q. The Government of India would always give you a grant for your expenditure. They would not allow you the whole of the future revenue, but only as much as was required to cover expenditure?—Our assignment of revenue would be limited to the amount of our expenditure, but it would not be less. If therefore during the currency of each contract we utilized to the full all the revenue assigned to us including all the fresh revenue derived from the canal works, we must necessarily in each fresh contract get the net revenue from those works.

13. Q. With regard to the Western Jumna Canal you won't get the whole of the receipts of the Sirsa Branch; but only as much as Government of India likes to give?—I understand we should get the whole of the receipts; the proposal of the Finance Committee was that these specially Provincialized works should remain outside the contract.

14. Q. If you got the whole of the receipts they will be outside the contract?—That is how I understand it.

15. Q. Will it remain outside the contract?—Yes, I understand that to be the proposal of the Finance Committee.

16. Q. Supposing you lost, you cannot pay the interest?—We should have to direct some of our revenue from the ordinary Provincial contract to cover the loss.

17. Q. Might it be for all time outside the contract?—Yes.

18. Q. If they give you revenue on one hand and retain it under another, where is the responsibility?—These works are designed as productive works; we should upon a given number of years always make a profit out of them; taking year by year the loss of one year would be made good out of the profit of another, but the result on a series of years would, I should think, if the works fulfilled the estimated expectations of them, certainly be a gain.

19. Q. Supposing the canal was a losing business?—Then, presumably, we should set about readjusting the accounts of the canal, we should have to reduce the maintenance expenses.

20. Q. If you made a large profit in five years would not that reduce the assignment?—I should not expect that to do so. I expect the Government of India would call upon us to spend all the profits on works of a similar kind.

21. Q. (*Mr. Ibbetson*). The profit made on the Provincial loan account goes to the Government of India at the end of the contract unless the Local Government absorbs it?—Yes, that would be so, but I should explain that there has not, on the contract, as a whole, been any profit to the Local Government from the loan account; if you refer to the last paragraph of my note you will see that the profit has been assigned to us for expenditure.

22. Q. It is accounted for in the contract?—Yes.

23. Q. During the current contract you made Rs. 40,000?—Yes.

24. Q. As regards the Sirsa branch, it is a Provincial work. Would the maintenance expenses of the canal so provincialized include a charge on account of water deli-

vered at a point at which the branch takes off from the main canal?—I do not know, but believe there would be no such charge.

25. Q. As regards the management of the Sirsa Branch, is it kept separate and paid for separately?—I do not know.

26. Q. (*Mr. Wilson*).—It has not been provincialized?—No. The engagement was that it might be provincialized after ten years of working—it has been working for ten years now.

27. Q. With regard to what you said to Mr. Higham the question is so important that I must ask you to look at para. 4 of the note on Provincial works, where you say it says "every such arrangement the Finance Committee contemplated would be a separate and subsidiary one not part of the regular provincial contract; first because it is obvious that its duration must be fixed on special considerations and may or may not be the same as that of the regular contract." Is not that an arrangement by which the Imperial Government provides funds and does not ask for interest during the non-paying time of a work and is not that the period for which the contract would be made?—No, I do not understand it so. The Provincial Government would have no financial interest in the canal during its construction; after it had been working ten years it might become a Provincial work; the period for which Provincial would take it over a different period from the ten years spoken of with regard to construction.

28. Q. Has not the Provincial Government some concern with the interest?—It would be added to the capital charge for which Provincial became liable.

29. Q. The Provincial Government is concerned with the interest though it does not pay it?—Yes.

30. Q. I understand that to avoid the difficulty which the Provincial Government finds in paying interest on a work which is returning nothing for a certain period an arrangement was made by which the Imperial Government would pay that interest, but for that period the whole transaction would remain outside the contract, at the end of that period the arrangement would cease and it would then go into the Provincial contract, you think that wrong?—Yes.

31. Q. If it is as you think, it is all we want?—I think so.

32. Q. You say that Government have granted on the Provincial loan account Rs. 40,000 a year besides paying 3½ per cent. interest?—Yes.

33. Q. You said that ultimately, at all events, the Rs. 40,000 go to the Government of India?—Yes, because in the contract it is appropriated for other Provincial expenditure.

34. Q. If the rate of interest were reduced from 6½ to 4 per cent. the Rs. 40,000 would disappear?—It would be 3½ per cent., that is the interest we now pay to the Government of India.

35. Q. Ultimately under the Provincial contract system would that loss be incurred by the Provincial Government or the Government of India?—It would depend upon whether we surrendered the interest of our own motion or by agreement with the Government of India. I should expect the loss to be made good to us in the next contract. This gain is really a grant to us to meet Provincial expenditure of a general kind. If we surrender the interest we practically give up a grant for general Provincial expenditure; in other words we should have to be satisfied with a grant running below our expenditure to the extent of Rs. 40,000.

36. Q. If the Government of India agreed to forego the interest there would be no loss to the Provincial Government?—No, there would be no loss; the Government of India would presumably assign to us the same amount of revenue derived from some other source.

37. Q. I think the loss in the last ten years on non-payment of loans comes to one per thousand?—I have not made the calculation, but the loss would be small.

38. Q. It would be quite insignificant?—Yes.

39. Q. If the Government of India agreed that such loans might be given free of interest how would that work, as between the Imperial and Provincial Governments? Suppose the Government of India agreed that the Punjab Government might give Rs. 10 lakhs a year for the construction of wells free of interest?—It would not affect the account between Imperial and Provincial:—So much revenue and expenditure would disappear from the Provincial accounts.

40. Q. Is it not the case that, during the famine and improvement loans were practically stopped throughout

the Province?—I cannot say. There has been no great reduction in the grant of loans since 1895-96.

41. Q. You said that one scheme for a Provincial work had been held in abeyance for want of funds?—Yes.

42. Q. Is it not the case that the Local Government was unable to advance Rs. 18,000 for a survey in Dera Ismail Khan?—Yes. The money has been allotted in the current year, but as far as I can judge the project would have been thrown out for want of funds, if it had been brought forward earlier.

43. Q. Supposing at this moment a scheme were worked out costing Rs. 10 lakhs and promising a good return, could the Local Government advance the money?—No, they could not take it up.

44. Q. Would it be difficult to get such a grant from the Government of India?—They would have to give us a loan or make the work and then provincialize it.

45. Q. The Provincial Government is not in a position to start by itself a large scheme of that kind?—No.

46. Q. Not even to undertake a large survey?—No, Mr. Laville. not an expensive survey.

47. Q. Are any District Boards likely to take up a scheme costing Rs. 1 lakh?—No. District Board has money enough for that.

48. Q. What has been the financial result to District Boards of such canals as they have taken charge of?—The two District Boards that have constructed canals have made a profit, Peshawar of 20 per cent., in the Michni-Delazak branch of the Kabul river canal and Karnal of 1½ to 1½ per cent. on the Sirsuti canal.

49. Q. Were these canals constructed at the cost of the District Board?—Yes, from loans advanced by the Government of India, the Imperial Government.

50. Q. What interest do they pay?—Four per cent.

51. Q. Would there be any difficulty in another District Board getting a loan in order to construct canals?—I believe not. We had no difficulty in securing these particular loans of Rs. 24,000 to Karnal and Rs. 25,000 to the Peshawar Board.

29 Oct. 01.

WITNESS No. 12.—MR. R. HUMPHREYS, I.C.S., late Deputy Commissioner, Hissar.

Note I, on points to be considered regarding the Hissar District.

Point 2.—The canals which irrigate the Hissar District are—

- (1) the Western Jumna Canal;
- (2) the Sirhind Canal;
- (3) the Ghaggar Canals with the Rangoi and Joya Nullahs.

The Western Jumna Canal I fear offers little scope for extension as far as the Hissar District is concerned at any rate; in fact at present the complaint is that in some of the branches the supply is not always sufficient to bring the crop to maturity independently of rain.

It should be always remembered that in Hissar rain can never be depended on, and the area to be given canal water should, as a rule, not be greater than that for which the Department are certain they can give sufficient water to mature the crop, supposing there were no rain. If any extension should be possible in view of the completion of Mr. Kennedy's remodelling scheme, referred to in the Irrigation Department note, it should be undertaken without delay.

There are a few irrigated villages in the Bhiwani Tahsil right at the end of the Sirhind Canal. These villages usually complain of insufficiency of water-supply.

- (b) A few villages in the Dabwali Sub-Tahsil get water from the Sirhind Canal, but they can hardly count on it as the canal there is really almost solely an escape channel.

I see by the Irrigation Department note on this canal that large extension is capable in the Sir-a Tahsil. The difficulty appears to be to arrange for the requisite extra supply and its conveyance through intervening native territory. Surely in view of the insecurity of the tract affected and of all that it has passed through in recent years every effort should be made to overcome the difficulties with as little delay as possible.

- (c) The Ghaggar Canals and the Rangoi and Joya cuts were developed by famine works during the famines of 1896-1897 and 1899-1900. I would refer to paragraph 57 and 58 of the Hissar Famine Report of 1897, and to paragraphs 40 and 41 of that of 1900.

There still remains a work on the famine programme of the district, No. 6. Tahsil Fatahabad, in connection with the Joya above its junction with the Rangoi cut. This is not a very extensive work, and when completed will, I fancy, have extended the utilization of the water of the Ghaggar (as far as present available) as far as it is possible to do so. I do not consider this work of such importance as to warrant its being done by ordinary labour.

There are no private canals in the district. In the Irrigation Department note on the Hissar District a certain area is shown as irrigated from private canals. This, however, is really irrigated from the Patlana system and the water-rates are paid to the State. This refers to the villages of the Buhlinda tract.

Colonel Jacob before he left raised the question whether, in view of the liability of the Hissar and Rohtak Districts to famine, the cultivation of sugar-cane and cotton on the Western Jumna Canal in these districts should not be forbidden owing to the greater amount of water necessary to mature these crops as compared with food grain and fodder crops. The correspondence which took place on the subject is put up, and it will be seen that the question had to be dropped.

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Point 6.—Wells in Hissar.—Please—see—

Hissar in Appendix A to draft Famine Code.

Hissar Famine Reports, 1897, Section 24 and Section 101.

Hissar Famine Report of 1900, Section 13 and Section 110.

As a general rule the district is unsuited for well irrigation excepting (1) the Solar near the Ghaggar where the people, mostly Pachtas by caste, are too lazy to dig or work wells, and where they prefer to trust to inundation for their irrigation; and (2) in the Hansi Tahsil where it is unnecessary owing to sufficiency of canal irrigation. In the case of the Solar, however, the building of *pakka* wells should be encouraged in every way. The water is not deep—30 to 50 feet—and a well costs from Rs. 300 to Rs. 500 according to circumstances. The supply of water even in dry years is almost unlimited, and the area irrigable is practically only limited by the number of bullocks available to work it. Owing to the pressure of the underground flow, *kachcha* wells cannot be successfully worked in this tract.

As mentioned in the passages in the printed papers above referred to, well irrigation is also possible in parts of the Hissar and Bhiwani Tahsils, and during the famine numbers of wells were dug there. The difficulties here are (1) the depth of the water which varies from about 60 to 110 feet, and ordinarily wells which are deeper than 60 feet cannot be profitably worked; (2) the uncertainty of finding sweet water or that the water even if sweet when found will remain sweet when worked continuously; and (3) the expense of digging wells.

On account of the first two difficulties it will be seen that ordinarily wells are not workable in these tracts and that they will only be resorted to in bad years as means of avoiding famine and its effects.

The only suggestions which I think can be made in this respect are (1) that on the approach of famine efforts should be made to induce the people of those villages in which *kachcha* wells can be dug, to dig them, by the offer of *takavi* on liberal terms, and of loans if necessary under the provisions of Section 90 (c) of the draft Famine Code.

As famine usually begins by the failure of the monsoon, these arrangements should be made in time to allow of the new wells being used for a *rabi* crop. After famine then I think efforts should be made to get those *kachcha* wells which proved themselves to be good during the famine. This will really be found to be very difficult, as after a famine people have little resources and would no

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even take a loan for the purpose, and in good times the people could hardly be brought to see the necessity for spending money on a well which they would not then be using. However, I consider that efforts in this direction should be made, and probably here and there people would come forward who would spend the requisite amount of money as 'dhormoth.'

Point 8.—See Hissar Famine Report, 1900, Chapter VI.

There were no works uncompleted at the end of the famine which should be completed by ordinary labour.

Point 9.—The District Famine Programme is ample for all the requirements of a severe famine.

The great majority of the works are tank works as to whose utility I would refer to the last paragraph of Section 43 of the Hissar Famine Report of 1900 and to Section 53 of the Punjab Government Resolution on the famine of 1899-1900.

What applies to the large tanks also applies to the small village tanks which are on the programme.

The works are very numerous and are well distributed over the district.

Should famine works unhappily be again necessary this cold weather the obvious course would be to commence on the tanks which were left unfinished at the end of the last famine.

Note II on point No. 9 of memorandum of points to be considered by the Commission.

(1) *Districts for which programmes have and have not been prepared.*—See Draft Code, Section 30, which reproduces the corresponding section of the existing Punjab Code.

(2) *Examination of programmes.*—The famine programmes which have been prepared for the 18 districts or parts of districts mentioned in clause (1) are put up in print. In framing them the principle has been kept in view that

at least so many people should be provided for as the experience of the last severe famine of 1899-1900 showed. would be likely to need assistance on famine works should unhappily famine recur. They are in every case ample for the purpose as can be seen from the following figures for the districts most liable to famine and bearing in mind that the famine of 1899-1900 was probably the most severe on record:—

District.	Number of labourers works can support for six months.	Highest average daily number in any week during 1899-1900 famine.
Hissar	531,351	161,561
Rohtak	57,010	33,632
Gurgaon	81,899	18,153
Dolhi	23,609	4,374
Karnal	42,433	14,075

(3) *The utility of the works provided.*—The works on the programmes consist mainly of the following kinds:—

(a) Irrigation which will be dealt with by the Irrigation Branch.

(b) Prevention of floods and bunds, e.g., Gurgaon vide Mr. Hallifax's note.

(c) Tank works, e.g., Hissar note.

(d) Road works, e.g., Hissar note.

(4) *Arrangements for maintaining, extending or completing programmes.*—See Section 27, Draft Famine Code which reproduces the corresponding section of Punjab Code with verbal alterations merely.

1. Q. (*The President*).—You are Senior Secretary to the Financial Commissioner?—Yes.

2. Q. You have had personal experience of famine in Hissar?—Yes.

3. Q. What numbers were you dealing with there?—Our largest number was something like 165,000, not on only but on famine relief of every kind—people on works, dependents on works, poor-houses and gratuitous relief in the people's homes.

4. Q. When the famine came upon you, had you programmes of works which were likely to be useful?—No, the programmes had been practically exhausted of everything useful by the famine of 1896-97, and we were not expecting a second famine so soon after.

5. Q. In what capacity may I ask were you in Hissar at the time?—I was Deputy Commissioner.

6. Q. You say in your note "it should be remembered that in Hissar rain can never be depended on, and the area to be given canal water should as a rule not be greater than that for which the Department are certain they can give sufficient water, supposing there were no rain." Has that arrangement been made with the canals?—No special arrangement has been made. People very often complain that the Canal Department occasionally gives them a preliminary watering and afterwards when the crop comes to mature there is no water available and they have to pay the rates.

7. Q. Are there many wells?—No, for irrigation purposes there are very few.

8. Q. What is the reason of that?—The depth of water below the surface; there are only two places where you can make wells.

9. Q. What is the remedy for this?—I don't know. It most difficult to say. There is one thing about the Sirhind

Canal, it said there is a large *chak* which is commanded by the canal and which is irrigable if a supply of water could be conveyed; beyond that any extensions that may hereafter be possible are out of the Western Jumna Canal or by passing water down the Ghaggar. I believe from what I have heard that it may be possible to turn into the Ghaggar some more of the hill torrents in the Umballa District. I have no knowledge myself of this.

10. Q. What are the circumstances of the Hissar rainfall? It is very variable. Occasionally they have very good years, in fact up to 1896 there was no complaint; they had occasional famine and scarcity, but they could get on very well; the assessment is very light, and if they got one good year in three or four, they could manage to pull along—it is only in exceptional years like at the last famine that they don't know what to do.

11. Q. You contemplate something like a third famine coming on?—I don't think it will be anything more than severe scarcity.

12. Q. It will come on to an impoverished people?—They have lost the *darani kharif* and probably there will be nothing in the *rabi* unless the rains come.

13. Q. Does that affect Sirsa too?—Yes.

Mr. Wilson.—explained that Sirsa district had been broken up into two, part had gone to Hissar and part to Ferozepore. Sirsa was now a Sub-division of the Hissar district.

14. Q. (*The President*).—I suppose there is no possibility of water storage?—That was our idea in the last famine—digging large tanks with the idea of having a perennial storage of water, mainly for cattle and for human consumption. We have not yet been able to say whether that will succeed or not. Of course newly dug tanks will not hold water for a year or two, they fill up very well, but they don't hold water well.

15. Q. (*Mr. Higham*).—Will they carry on from one season to another?—It is hoped they will.

16. Q. Are not all the tanks filled from canals?—Two or three are.

17. Q. (*The President*).—The water is very deep in the wells, still it is there?—Yes.

18. Q. Do you think they would take to wells if it was made easy for them?—They won't take to them permanently. They work wells where they can be worked in bad years, but it is very hard to get them to take money in a good year.

19. Q. With a view to protection against famine, if there was a Government scheme on a large scale for sinking wells?—That would be purely protective.

20. Q. As a protective measure is it worth while?—No doubt it is, wells for irrigation purposes outside the Ghaggar Valley and Hansi can only be made in parts of Hissar.

21. Q. Is there still a population?—Yes, they use tanks, in the last famine they had to go miles for water and then it was often brackish.

22. Q. Is there any population to speak of?—Yes, and strange to say the population has gone up in the last decade.

23. Q. This is a very serious state of affairs, what measure do you think is the best for meeting it?—I think the only thing to do is to encourage well digging wherever possible by the grant of loans, and if a famine is impending by the free gift of money for wells so that they may be able to get *kacheha* wells dug.

24. Q. What would be the depth?—Anything over 80 feet would be impossible.

25. Q. What is the limit for profitable working?—Sixty feet.

26. Q. And that is the depth or the greater part of the district?—Yes.

27. Q. (*Mr. Wilson*).—What is the population of the district?—776,000 and they are scattered.

28. Q. (*The President*).—What do they do?—They used to count upon one good year in three or four, I have heard it said that if they have one good year they can pay revenue for the whole term of the assessment; they have extremely good crops when they do get them; in the *kharrif* of 1900 they had beautiful crops. The protection of crops is absolutely impossible to any appreciable extent.

29. Q. Then we come to the next thing, facilities of communication, what about that?—The railway has done wonders for the district, which is well served in that respect; it has got the Rajputana-Malwa and Southern Punjab railways.

30. Q. (*Mr. Ibbetson*).—They are primitive folk?—Yes.

31. Q. Are they to a great extent accustomed to leave their homes?—Yes, they are leaving their homes now, but they will return to them.

32. Q. You say that ample provision has been made in the programmes of famine works. Instead of working out the figures as has been done, would it not have been better to take the actual figures of requirements as based on experience?—Yes.

33. Q. How long have you been Deputy Commissioner of Hissar?—For two years. I came just before the famine began.

34. Q. With regard to what you say in the second paragraph of your note, I should like to ask why you would deny the water that you can spare because you cannot give more. Half a loaf is better than no bread?—Unless you can give them water afterwards to mature the crop it is unkind to give them water which would lead them to sow, and for which they would probably have to pay the cost of the preliminary watering, also the cost of their seed and labour in sowing.

35. Q. How are the canal people to tell whether there is going to be no water or not?—They know more or less; if they have reason to believe that there would be a shortage later on, they should arrange accordingly.

36. Q. It amounts to this, that you have water to spare but you do not give it for fear you may not be able to give more subsequently?—In an ordinary year there would not be any danger, but in a year in which there is fear that the water may not be able to reach them later, it would be better to allow it to go waste or fill their tanks.

37. Q. You would not push the first watering, if you could not expect to carry it through?—No.

38. Q. (*The President*).—What is this remodelling scheme of Mr. Kennedy's?—That is a scheme on the Western Jinnah Canal for reducing the number of water-courses and economising the water.

39. Q. (*Mr. Ibbetson*).—In the Sotar you say that the water is at a reasonable depth and wells can be constructed with ease, but the people are too lazy to dig wells and prefer to trust to inundation. Is it a mere question of laziness? Supposing you offered them money on partly recoverable loans or reduced the interest, or remitted it altogether would that induce them to undertake the wells?—There is no difficulty in dealing with *Jats*, but the *Pathanas* are very hard to deal with, they have uomanio instincts strong in them, they have no thought for the future whatever, they will accept a loan gladly, spend half on digging a bit of the well and go off.

40. Q. It is proposed to make over the Rangoi Channel to the District Board, but the District Board is nearly bankrupt,—will that work; have you had any experience of District Board management of canals?—No.

41. Q. What arrangement is to be made about clearance is it to be done by forced labour or paid for by a cess?—By a water rate.

42. Q. The District Board being responsible for the whole?—Yes. In the old days before the thing had been undertaken by the Irrigation Department during the famine year, it used to be managed by the villages themselves; the villages used to *back* the amount necessary and pay the cost of clearance among themselves and then the work had to be done under the supervision of the *Tahsildar*.

43. Q. Could they not manage it now; I suppose they hadn't the energy or power of combination?—No; the scheme has been too far developed to be so managed.

44. Q. (*Mr. Wilson*).—This programme of famine relief works consists of tanks in the Sirsa district?—Yes.

45. Q. Have they been examined by a Public Works officer on the spot?—The large tanks have, the smaller ones have not.

46. Q. Many of the smaller tanks are very small?—Yes.

47. Q. You have a number here which can employ 5,000 labourers for six months?—Yes, they are 1,200 × 600 × 16.

48. Q. (*The President*).—How do they fill?—From the rain.

49. Q. Are they for irrigation purposes?—The main idea was that they should be drinking tanks, but it was hoped that they would also irrigate.

50. Q. What is the average rainfall of Hissar?—A good average year would be 18 inches, it varies tremendously from place to place, in the famine year there was less than 8 inches.

51. Q. How is it that this district with such an uncertain rainfall can maintain so large a population?—They have got their cattle and their camels which they make a good deal of money out of, and they have good years now and then.

52. Q. The soil is good?—Excellent.

53. Q. If irrigation could be extended to it, it would produce good crops?—There is no doubt of it.

54. Q. (*Mr. Wilson*).—As to the question of the water-supply being spread over too large an area when the rainfall was not sufficient to bring the crop to maturity: does not the Canal Department simply give a certain amount of water to the village and the village decides how far it should be spread?—Theoretically, they are not supposed to irrigate more than a certain area, but they do it.

55. Q. Then it is not the fault of the Irrigation Department that a greater area is irrigated than could be brought to maturity?—No.

56. Q. Would not one remedy for the state of things that exists in Hissar be to give liberal remissions of canal rates in a year of scarcity except on crops which come to maturity?—Yes.

57. Q. Don't they remit the first—watering rate if the crop has failed entirely?—I could not say off-hand. I don't remember instances of it.

58. Q. I understand wells are not fully worked in an ordinary year?—No.

59. Q. If encouragement were given for the sinking of wells, could not the available supply in the canals be made to go further?—Yes.

60. Q. Would it be advisable to take action to this end; that is to say, give less water to the people near the canals and help them to make wells?—I think so.

Mr. Humphrey.

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Mr. Humphreys. 61. Q. And Government might encourage the sinking of wells by remitting a part of the advance?—Yes.

29 Oct. 01. 62. Q. From a general point of view in Hissar should not Government give irrecoverable advances to make wells in the cultivators order to have more security against famine?—Yes.

63. Q. As to this project of making over the Ghnggar canal to the District Board of Hissar, would not the maintenance charges be a part of the ordinary expenditure of the District Board?—Yes.

64. Q. When scarcity comes to Hissar does not their income fall very much? Have you not to reduce expenditure?—Yes.

65. Q. Would not the canal suffer in consequence very much?—Yes, personally I was never in favour of the District Board taking over the canal. I advocated it should remain under the control of the Irrigation Department.

66. Q. In Hissar in a year of scarcity or famine the District Board's income falls and it is difficult to carry on.—Would it not be difficult to maintain the canal in full working order?—Yes, because there is no income from the canal.

THIRD DAY.

Lyallpur, 1st November 1901.

WITNESS NO. 13—PANDIT HARI KISHEN KAUL, Settlement Officer, Muzaffargarh.

Pundit
Hari Kishen
Kaul.

Note by witness on the Inundation Canals of the Muzaffargarh District.

1 Nov. 01.

Canals at last settlement.—This is a district depending very largely upon canal irrigation. All the canals in the district are inundation canals and almost all of them belong to Government, although they all belonged at one time to the zamindars. Even before Diwan Sawan Mal's rule, i.e., long before the annexation of the district, "most of the present foundation canals had been made by the inhabitants of the district under the guidance of the former rulers, the situation of the district being one affording great facilities for the construction of such canals, without the aid of which cultivation, except to a limited extent by wells, would be almost impracticable." I have quoted the above from literature existing on the subject. A history of the canals as they stood at last settlement so as to be able to contrast their condition with the existing state of affairs. The canals were not in professional hands at that time and were managed by the Deputy Commissioner of the district. Annual clearances were effected by the irrigators by a system of statute labour called *chher*. The amount of clearance to be done on each canal was decided by a committee of *Sarpanches* (who were supposed to be representatives of the irrigators), and the labour required for this as well as for any work in the way of protective embankments on a small scale needed for the maintenance of the canals, was distributed over the irrigators. The system of protective embankments was not complete, and although considerable portions of the district had been well protected either by labour supplied by irrigators or from money provided by Government, yet there were gaps left between different embankments and particularly at the places where canals crossed the protective works, the result being that any unusual flood not only caused considerable injury to crops irrigated from the canals, but also seriously damaged the canals themselves. Nevertheless the canals then irrigated over 200,000 acres of land in the whole district out of a total cultivated area of about 400,000 acres, of which 118,000 acres depended solely upon the floods of the river.

2. Improvements made by Canal Department.—The management of the canals was made over to an Executive Engineer in 1890, and the first improvement made was to construct regulators for all the canals at the places where they crossed the protective embankments. At the same time steps were taken to fill up the gaps between the various protective works and make the embankment on the Indus side a continuous one. No new canal has been dug out of either of the rivers, but the existing main canals have been improved and widened where necessary, small branches of these canals have been amalgamated to some extent, and the distributaries have been extended, resulting in a very considerable increase in the area irrigated from canals, viz., from 200,000 to 333,429 acres. The total length of the canals of the district is 1,863 miles now against 439 miles at last settlement. These facts appear from Statement I,

which shows figures for each main canal of the Indus and Uchrah Series. It is not for me to review from a professional standpoint the improvements that have been made; but the main objects in view have been extension of irrigation and a constant supply, and the figures show that much success has been attained in both those directions. There has been an increase of about 67 per cent. in the area irrigated from canals, and the figures given in Statement II appended to this note show that during the past ten years not only have the variations in the irrigated area been very small, but there has been a steady development except in the years 1898-99, 1899-1900. The former was a bad year, in which the rivers ran unusually low during the summer and the latter was the famine year, when the drought largely affected the supply of water in the rivers. The irrigated area has during the past year, more than regained the ground lost in the two preceding years. The figures of revenue credited to the Canal Department during the past ten years are given in Statement III.

3. Financial position of the canals.—The improvements made by the Canal Department up to 1891-93 were discussed in a note, dated 18th September 1896, prepared by the Chief Engineer, Irrigation Department, which was submitted to the Secretary to Government of India, Public Works Department, with letter No. 1657 I., dated the 11th December 1896, from the Secretary to Government, Punjab, Public Works Department, Irrigation Branch, and the capital outlay on these canals up to the end of the year 1895-96 as hitherto charged to the agricultural grants was put down at Rs. 9,93,207. The expenditure incurred since on works which have been completed, appears to have been as follows:—

	Rs.	Rs.
(1) Inspection houses and offices—		
(a) Executive Engineer's residence and office	17,161	85,478
(b) Other offices, etc.	6,592	
(c) Rest-houses	12,725	
(2) Construction of new heads, etc.	37,751	
(3) Strengthening protective embankments	56,945	
(4) Constructing regulators	37,343	
(5) Bridges	3,339	
(6) Extension of canals	295	
(7) Fixing concrete blocks	5,500	
TOTAL	1,60,716	

I have obtained these figures unofficially from the Executive Engineer, Canals. Adding this to the outlay reported in Chief Engineer's note of September 1896, the total cost to Government has been Rs. 11,65,013 since the assumption of the charge of the canals by Government in the Public Works Department. It will be understood that the annual clearances and ordinary protective works are carried out with the *chher* labour supplied by the people under the arrange-

ments sanctioned at last settlement. The absentees pay a fine called *zar-i-nagha*, and the proceeds of this *zar-i-nagha* are utilized for sundry expenses, which are not debitable to the capital account. Under the system of assessment sanctioned at last settlement (and which I proposed to adhere to), most of the revenue of canal-irrigated lands was fixed, and the Canal Department were to receive book credit for all the revenue on the nahri and two-thirds of the revenue on the chahi-nahri lands. The amount to be credited to canals in this manner was estimated at Rs. 2,27,520 per annum. The actual credit received has, however, been considerably more. Even the annual credit of Rs. 2,27,520 would give a return of nearly 20 per cent. on the capital outlay of Rs. 11,65,013. There is, however, another aspect from which the financial position of these canals may be viewed. It may be urged that the canals, as they existed at last settlement, were calculated to bring in a revenue of Rs. 2,27,520 debitable to canals, and that Government was not incurring any considerable expenditure on the canals in that condition. For a return on the capital laid out on these canals since then, we must look at the excess of revenue over the credit provided by Mr. O'Brien (the Settlement Officer). The credit received from 1880-81 to 1891-92 was Rs. 47,23,223. The amounts credited to canals during the succeeding years are:—

	Rs.
1895-96	2,44,132
1896-97	2,56,310
1897-98	2,57,891
1898-99	2,56,452
1899-1900	2,52,938
1900-01	2,55,363
TOTAL	15,23,058
Add	37,43,223
Total credit received	52,66,281

According to the estimate framed at last settlement, the Canal Department should have received credit for Rs. 2,27,520 × 21 years = Rs. 47,77,920. The excess receipts therefore amount to Rs. 4,93,361 against a capital outlay of Rs. 11,65,013. It may therefore be said that so far Government has lost (Rs. 11,65,013 - 4,93,361 =) Rs. 6,71,652 over these canals. It must, however, be remembered that the excess collections are made up chiefly of fluctuating revenue on extended canal irrigation in tracts under fluctuating assessment or of the water-rate charged (at 6 annas per acre in Tahsil Sinanwan and 8 annas per acre in the other two tahsils) in tracts under a fixed assessment on lands not assessed at last settlement as irrigated from canals. The full advantage of the extension and improvement will therefore not be apparent till the new assessment which has now been proposed is introduced. Nevertheless, treating the outlay as capital, the excess receipts alone, which have averaged Rs. 23,493 per annum during the past 21 years, represent a return of 2 per cent. on it, which, though small, is not a negligible quantity. According to my proposal, which have not received the sanction of Government yet, and which should only be taken as rough guides for the present, the revenue of the district will be as follows:—

	Rs.
Nahri	2,40,413
Chahi-nahri	2,02,328

The Canal Department will get credit for the whole of the nahri revenue and for two-thirds of the chahi-nahri jama. The total annual credit for the term of the next settlement will therefore be (Rs. 2,40,413 + Rs. 1,34,866 =) Rs. 3,75,279 per annum, which will give an excess of Rs. 1,47,779 over the sum promised by Mr. O'Brien. This excess will make up the deficit of Rs. 6,71,652 shown above in about five years, when the capital spent up to the present will have been repaid. And after that, the excess will mean a return of nearly 13 per cent. on the capital now worked out. It should also be borne in mind that the actual credit received hereafter will exceed the estimate, inasmuch as, according to my proposals, all canal irrigation extended to wells and patris not assessed as canal irrigated will be charged a rate of 10 annas per acre throughout the district (instead of 6 annas in one and 8 annas in the other two tahsils). It may also be mentioned that proposals have been submitted for the abolition of the ohher system and for the introduction of an occupier's rate which will cover the working expenses of the canals and bear a small margin, which will increase as irrigation is extended. The

above remarks will show that the canals of this district have been a remunerative concern so far, and promise to continue so.

4. *Proportion of protected to cultivable area in tracts subject to drought.*—Cultivation in the parts of this district which are secure from inundation depends mainly on canals. Wells are sunk to supplement the canal supply and to mature the *rabi* crops, but the canals are not supposed to supplement well irrigation. If a canal fails, the wells become helpless. There has, however, never been a total failure of a canal during the past 20 years, and there is no apprehension of such a thing occurring in the future. The only tract in which there is independent well irrigation is the Thal of Tahsil Sinanwan. In this circle there is practically no canal irrigation. Such is also the case with part of the Nahri Thal of that tahsil. In those tracts the wells do the best they can when there is, no rain, but the irrigation possible on wells unassisted by rain is very small, and the working of the wells in such years is not at all profitable; so no area can be considered protected from drought because it has a well in it. The only way of securing these tracts against drought is to extend canal irrigation into it, and I have proposals to make on the subject which I shall explain in the next paragraph and which I have held in abeyance on the idea that the Sindhi Sagar Canal, when constructed, would irrigate the whole of the Thal of this district, of which my proposals are to irrigate a part. As, however, there is some doubt at this moment as to the execution of the scheme of the construction of that canal, I shall not hesitate to put forward my views. The total area of the Thal of this district which is not under cultivation is no less than 5½ lakhs of acres, but part of it consisting of sandhills is not cultivable.

5. *Improvements recently made.*—Before stating what improvements I think are required, I should like to mention the chief improvements that have been made in recent years. It can be easily imagined that, when the canals were not in professional hands, there was a great deal of wastage of water, and the distribution was not fair. Water was sometimes running in a canal in which it was not needed, and had to be allowed to run waste somewhere, either sweeping a jungle or drowning people's crops. On the other hand, when water was running low, the influential men at the head of a canal used up all the water they could by raising stop-dams, and the poorer people at the tail had to eke out their existence without a drop of water. The banks of the canals were also not uniformly strong, and any extra influx of water resulted in a breach here and a breach there. To remedy these evils, it was necessary to strengthen the canal banks, to construct regulators, and to systematize the water-supply from the canals. These matters have been receiving attention all along, but they naturally take time, have been and it has been found possible to do a good deal during the past four or five years. Another very important requisite was the protection of the canal-irrigated tracts from floods, and this has been attended to from the very beginning. A good deal has, however, been done lately toward raising and strengthening the Chenab and Indus flood embankments. Special attention has also been paid recently towards amalgamating channels which used to flow very close to each other, resulting in a more effective control over the water-supply. A very great improvement which has just been started is the amalgamation of water-courses. At present there are numberless outlets on each canal, and a piece of land that could be thoroughly watered from one outlet has half a dozen of them in different places. Moreover, each irrigator will take a separate outlet, and the water-courses will run parallel for considerable distance alongside of each other. The wastage of water is thus very great, and the control of the supervising staff on the discharge of water very small. This work will, however, take time, as it must be done with great care, for the risk of overdoing it should be guarded against and all injury to lands receiving irrigation studiously avoided. Such are the improvements that have been recently made. But there is a lot more that can be done and which I venture to think should be done.

6. *Proposed improvements.*—In stating my proposals for improvements, I shall only deal with special projects of some magnitude and leave alone small extensions of irrigation on the existing channels wherever there is room for them. My proposals may be divided into four heads, viz.:—

- (1) Construction of regulators;
- (2) Construction of *pukka* outlets;
- (3) Amalgamation of canals; and
- (4) Extension of canals.

I shall deal with each head separately

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7. *Regulators.*—It is of extreme importance that regulators should be constructed at the heads of the canals so as to be able to regulate the supply according to the requirements of each canal. Moreover, by connecting adjoining canals with each other, the surplus water in one canal can be utilized in the others where water is badly needed. A very large number of regulators is needed, and the Executive Engineer roughly estimates the cost of constructing all of them at Rs. 1,50,000.

8. *Outlets.*—The second important thing to be done is to build *pakka* outlets on the canals. The outlets are at present mostly *kachcha*, and not only result in considerable waste of water, but do not allow any effective control on them. In building these outlets the number of outlets can also be very considerably reduced and water-courses can be amalgamated. The ramudras cannot, however, afford to bear the cost of building these outlets, and it has been agreed that Government in the Canal Department should defray the expenses. The cost has been roughly estimated by the Executive Engineer at Rs. 1,30,000.

9. *Amalgamation of canals.*—Under this head, I have to mention the contemplated amalgamation of Talirwah with Jhangar and Ali Khali. These are three canals of the Chenab Series, and the necessity of amalgamating them has been recognised by the Canal Department. So I need not dwell upon it at length. The cost has been estimated at Rs. 1,23,141. The proposals under the three foregoing heads are calculated to ensure a more satisfactory working of the canals, a more economic use of the water-supply, and will naturally result in extension of cultivation. But it is difficult to form any idea as to the extension that will result and the additional revenue that will accrue therefrom.

10. *Extension of canals.*—I have five suggestions to make under this head:—

- (a) The Suleman Canal can be extended into the Chahi Sullab Circle of Tahsil Alipur, and can command some 13,000 acres of waste land. The Executive Engineer roughly estimates the project at Rs. 30,000.
- (b) Branches of the Puran Canal, if extended into the central tract of Tahsil Alipur, can command some 10,000 acres of waste. The extension would, in the Executive Engineer's opinion, cost Rs. 50,000.
- (c) A new branch of the Maggi Canal from Dandewala to Karamdand Kurehi will be able to irrigate about 6,000 acres, and should cost about Rs. 30,000.
- (d) Branches of Magasson, if extended, will command some 10,000 acres of waste, and the Canal Engineer thinks the project will cost about Rs. 50,000.
- (e) The most important of the projects is to extend the Mohanwah and Indus canal into the Thal. This proposal is made only in case the project of constructing the Sind Sagar Dam canal falls through. The project is estimated to cost Rs. 6,35,195. The canal will run right across the Sinanwah Thal, and will irrigate the lower half of it. It will command some 250,000 acres of waste, and, supposing that more than 40 per cent. of the area would not be fit for cultivation, it will be able to irrigate about 100,000 acres.

11. To sum up, the cost of the projects and the area commanded will be as follows:—

	Area.	Cost.
	Acres.	Rs.
(a) Extension of Suleman	13,000	30,000
(b) Extension of Puran	10,000	50,000
(c) Extension of Maggi	6,000	30,000
(d) Extension of Magasson	10,000	30,195
(e) Extension of Mohanwah	100,000	6,35,000
TOTAL	139,000	6,75,195

The extension of the Suleman will be in the Chahi-Sullab Circle and that of the Maggi in the Bet Sind Circle. Both the circles will be subject to fluctuating assessment, and the extended cultivation will at once begin to pay the average rate of about Rs. 1-2-0 per acre which has been proposed for nahri crops in these two circles. The rest of the extension being in assessment circles for which a fixed assessment has been proposed, it will bring an immediate revenue of only 10 annas per acre. The annual revenue to be expected from the extended irrigation during the currency of the next settlement will be as follows:—

	Rs.
Extensions of Suleman and Maggi . . . 19,000 acres at Rs. 1-2-0 per acre =	21,375
Other extensions . 120,000 „ „ Rs. 0-10-0 „ =	74,000
TOTAL	95,375

This annual income of Rs. 95,375 will give a return of over 14 per cent. on the capital outlay during the currency of the next settlement, and will be considerably enhanced after the expiry of the settlement.

12. *Wells.*—Although cultivation in the greater part of this district does not depend mainly upon wells, yet they are of great help. Where canal irrigation is possible, well sinking should, I think, be encouraged. The number of new wells constructed and old wells put into working order during the past ten years is noted below:—

1890-91	422
1891-92	476
1892-93	565
1893-94	514
1894-95	287
1895-96	232
1896-97	243
1897-98	164
1898-99	225
1899-1900	405

I have not been able to get figures of newly constructed wells alone.

The only inducement offered for sinking new wells is that a protective lease is granted to wells which are constructed on land not already irrigated from a well, exempting them from assessment for a term of 20 years. Assistance is rendered in the form of loan for land improvement if application is made for it. The water level is very high in this district, and a well costs from Rs. 200 to Rs. 300. An average well irrigates about 10 acres of land if unassisted and 15 to 20 if assisted by canal water. I desire the sinking of wells would be stimulated by offering more liberal inducements and assistance on easier terms, but I do not anticipate any very marked improvement in this direction even with greater facilities.

13. *Flood protective or drainage work.*—There is not much remaining to be done in this district in the way of flood protective works. There is a continuous embankment along the Indus from the extreme north of the district down to the Chahi-Sullab Circle in Alipur and along the exposed bank of the Chenab River. It would be necessary to extend the Indus protective embankment lower down along the western boundary of the Chahi-Sullab Circle, if the project of extension of the Suleman Canal is carried into effect. There are certain tracts in this district in which the spring level rises to the surface of the ground in summer and where drainage works might be thought of as a remedy for water-logged condition. I doubt, however, if a drainage scheme would be feasible in the tracts I speak of. Besides, other remedies which are being tried have so far proved successful.

STATEMENT I.

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Kaul.

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Names of canals.	AREA.			LENGTH IN MILES.		REMARKS.
	At last settlement.	Irrigated in 1900-01.	Matured during 1900-01.	At last settlement.	At end of 1900-01.	
<i>Indus Series.</i>	Acres.	Acres.	Acres.			
Garku	0,175	15,013	14,413	Not entered in Settlement Report.	142	
Magaan	80,993	47,855	44,015	12	178	
Maggi	41,516	68,661	65,867	96	230	
Adil	10,546	11,010	11,512	12	12	
Ghattu	26,681	40,560	37,071	63	175	
Puran	31,010	43,303	40,309	105	232	
Surab	5,203	17,829	17,074	...	61	
Chaitwah	1,504	...	...	...	...
Suleman	3,291	21,314	20,735	11	72	
Total	165,919	266,547	251,990	297	1,114	
<i>Chenab Series.</i>						
Karam	637	7,511	7,576	22	35	
Ganesh	5,406	9,081	9,630	28	70	
Talari	14,004	27,564	27,470	47	65	
Jhangawar	7,791	7,681	7,691	17	21	
Alli Khalli	6,155	12,633	12,200	17	28	
Tolawah	1,025	...	...	6	...	
Gajjawah	826	970	874	5	...	
Total	36,610	64,372	64,161	112	230	
GRAND TOTAL	202,529	331,423	316,451	439	1,353	

STATEMENT II.

Canal.	1891-92.	1892-93.	1893-94.	1894-95.	1895-96.	1896-97.	1897-98.	1898-99.	1899-00.	1900-01.
<i>Indus Series.</i>	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Garku	17,192	15,632	14,137	13,076	11,615	12,660	13,165	12,750	12,797	15,013
Magaan	80,993	86,853	87,106	87,556	87,016	41,918	59,041	40,523	45,270	47,855
Maggi	43,534	67,635	61,505	65,197	65,091	61,120	64,123	61,123	65,651	68,661
Adil	12,104	11,625	12,316	12,193	12,005	12,013	13,618	12,110	11,176	11,010
Ghattu	31,044	34,510	38,667	36,607	35,218	35,111	40,831	31,750	34,110	40,560
Puran	43,524	41,410	48,122	49,213	51,781	51,920	50,402	47,148	36,601	43,303
Surab	17,291	20,701	18,720	19,840	19,581	21,950	21,553	20,681	11,862	17,829
Suleman	21,181	21,935	18,671	11,123	10,817	13,125	16,813	13,523	19,135	21,314
Total	244,738	273,413	219,917	252,126	216,911	251,247	263,937	215,821	239,564	266,557
<i>Chenab Series.</i>										
Karam	7,935	7,623	8,108	6,861	6,591	6,128	7,276	6,166	6,322	7,511
Ganesh	7,851	8,201	9,102	6,770	8,051	7,287	8,932	8,112	9,102	9,081
Talari	23,792	21,705	21,157	24,157	24,372	21,021	26,018	26,174	25,904	27,564
Gajjawah	937	891	911	940	912	950	1,011	1,005	960	970
Jhangawar	7,180	7,119	7,193	6,263	6,251	6,811	7,201	5,955	5,826	7,681
Alli Khalli	12,537	12,701	15,701	11,511	11,295	11,591	13,001	10,497	9,203	12,633
Total	69,919	57,807	67,993	52,694	57,127	56,951	61,185	53,769	57,377	66,872
TOTAL OF BOTH SERIES	305,058	311,225	313,035	301,730	301,063	308,198	327,532	301,133	296,939	333,429

STATEMENT III.

	1891-92.	1892-93.	1893-94.	1894-95.	1895-96.	1896-97.	1897-98.	1898-99.	1899-00.	1900-01.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Fixed rates	2,23,165	2,23,165	2,23,165	*2,23,165	2,18,529	2,23,165	2,23,165	2,23,165	2,23,165	2,23,165
Fluctuating rates	33,385	31,019	34,053	34,581	22,371	27,692	29,009	27,728	21,358	21,518
Not assessed at irrigated rates	5,017	5,223	5,725	1,000	0,232	6,272	6,740	6,509	6,305	8,380
Total	2,61,567	2,62,428	2,61,914	2,67,688	2,11,132	2,56,309	2,57,801	2,56,482	2,50,839	2,55,593

* Includes Rs. 5,527 remissions on account of flood damage in Muzaffargarh Tahsil. Difference from previous year's figures to be adjusted in current year's accounts.

Antique figures are correct figures.

Pundit Hari Kishen Kaul. 1. Q. (The President).—You are Settlement Officer of Muzaffargarh?—Yes.

2. Q. How long have you been there?—3½ years.

3. Q. Have you had any famine troubles there?—No, none.

4. Q. Have you ever had any famine experiences?—No.

5. Q. You have a very large area under inundation canals?—Yes.

6. Q. You say in your note "the amount of clearance to be done was decided by a committee of *Sarpandus* and the labour distributed over the irrigators." Do you think that system is practicable now?—No, I don't think so, that is why I proposed that the system should be abolished and occupiers' rates substituted.

7. Q. You think the *chker* system would not work?—I think not, there are many difficulties; besides, the system of charging a certain rate of statute labour on the irrigated area is not satisfactory.

8. Q. Besides that, do you think it does not work fairly as between the poor and rich?—Yes, there are many abuses.

9. Q. I talk of some experience of Egypt. Eighteen years ago there was statute labour to the extent of 250,000 men employed for six months in the year, and there the whole work of clearance fell upon the peasant proprietors. Was that the case here?—Exactly the same thing happened. The wealthy did not contribute at all, and the burden fell on the poor.

10. Q. As regards the management, do you think there is not the same amount of self-help among the agricultural classes as there was?—I am inclined to think there was never self-help among the zamindars here; local officers interested themselves in the irrigation, they turned the men out to see the canals cleared, and made them contribute towards any extensions that were necessary; but for the help of these local officers, the zamindars would never have done much.

11. Q. Inundation canals cease to run about September?—Some cease to run about September, some go on to the beginning of November, two canals are running now, and I expect they will go on throughout the winter.

12. Q. Right on to the next floods?—Yes.

13. Q. Have these canals been dug to an extra depth?—No, they used to run throughout the winter even, in past years.

14. Q. The *rabi* cultivation is started with irrigation?—Yes.

15. Q. How do they manage after that?—The canals run long enough for the *rabi* lands to be ploughed up, after that, they help the cultivation with wells.

16. Q. Are there sufficient wells to take up irrigation that has been begun by canals?—Very nearly.

17. Q. What is about the depth of water below the surface?—5 to 20 feet.

18. Q. Not more than 30 feet?—No.

19. Q. There are an immense number of wells?—Yes.

20. Q. All *pakka*?—Most of them are *pakka*.

21. Q. (Mr. Wilson).—There are 15,000 *pakka* wells and 2,400 *kacheha* wells in Muzaffargarh. How long do these wells last,—about 100 years?—I don't think the average life is more than 100 years.

22. Q. (The President).—People must have valuable oxen to work these wells?—No, they are not at all strong.

23. Q. (Mr. Ibbetson).—Is the Persian wheel generally used?—Yes.

24. Q. (The President).—Would it be a good thing for the country if these Inundation Canals were made perennial so as to take the place of the wells?—It would.

25. Q. Would it extend cultivation?—To a very considerable extent.

26. Q. You don't think that there are certain advantages in wells?—I don't think cultivation is possible in this tract without canal water. I don't think many people would refuse to take canal water.

27. Q. You have very little rain?—5 or 6 inches in the year.

28. Q. Will it be a popular change if you abolish this statute labour and substitute for it occupiers' payment?—When I proposed this change, everybody seemed in favour of it, but now that I have made it, many people don't like it; my idea is that, on the whole, the substitution of occupiers' rate for statute labour is much better for the people.

29. Q. Is there difficulty about getting the *chker* men to work?—In some cases they don't turn out to work; for example, during the *rabi* ploughings and during the harvesting operations there is great difficulty.

30. Q. You would find it difficult to get paid labour also at harvest time?—Yes.

31. Q. Is the question of headworks at the entrance of the canal a difficult one? Is much money spent on training the river past these heads?—No, a change is made where there is an erosion.

32. Q. Are there any regulators at the heads of the canals?—Not many.

33. Q. If you have a regulator, you cannot change the head?—On the Indus we have a system of side channels; most of these canals take off from these, which don't change.

34. Q. They don't get silted up?—Very rarely.

35. Q. Are the sand-hills an undesirable obstruction to irrigation?—Not as far as my district is concerned.

36. Q. In Muzaffargarh you would welcome the Sind-Sagar canal?—Yes.

37. Q. The effect would be to totally remodel these canals?—Yes.

38. Q. Supposing there was no Sind-Sagar?—I have made my proposals in my note. I would extend the Mohanwah (explained on map).

39. Q. How much irrigation is there on that canal?—250,000 acres, of which one lakh would be quite cultivable.

40. Q. If that canal were made, would you want a weir across the river?—No.

41. Q. Is it taken out of a creek?—Yes.

42. Q. Has there been any proposal made in this matter?—Yes, a rough estimate.

43. Q. Has this been surveyed for?—Yes, roughly.

44. Q. Is the land very fertile?—Fairly so; indigo, wheat, and sugarcane are grown.

45. Q. Do they use manure?—They cannot do anything without manure; they require it for the *rabi* crops—ordinary cattle manure.

46. Q. Without manure, they could not get a crop at all?—No, they get *kharif* crops without it, but for *rabi* they require it, and for sugarcane.

47. Q. Is the silt fertilising?—Yes.

48. Q. They don't require manure for the *kharif* crops?—No, some of the crops don't require manure, neither rice nor indigo.

49. Q. Which has the best silt, the Indus or Chenab?—The Chenab is much the better.

50. Q. Do you think any improvements can be introduced in the *takari* system to make it easier for a man to make wells?—I think there are some improvements that can be introduced.

51. Q. What can you suggest?—That the full term allowed for the repayment of the loan should be utilized; it is not utilized now.

52. Q. The Deputy Commissioner does not give as much time as Government allows him to give?—Exactly. I have examined the records, and find that in some tahsils the term is 7½ years; in others 11½.

53. Q. Does that depend on the personal opinion of the Deputy Commissioner for the time being?—I think so. I think we should give the full period of 20 years.

54. Q. Do you happen to know what the feeling of the Deputy Commissioners was; why they did not give a longer time?—Because the rules say that the loans should be repaid in as short a time as possible; and I don't think besides that the calculations are correctly made; a well in the Thal costs Rs. 300, and does not irrigate more than 10 acres—10 acres in the Thal cannot produce more than Rs. 80 worth of crop; or Rs. 2½ in rent—to the landowner. Recovery in 11½ years would mean an annual payment of Rs. 24 or more than the loan produces. Then again my second point is: Under the rules, enquiries can be made by the Kanungo; all the enquiries should be made by the Tahsildar or Naib Tahsildar unless the work is very heavy.

55. Q. (Mr. Ibbetson).—Would that mean much delay?—I don't think it should, because in the last 10 years the largest amount of *takari* distributed in my district, for example, was only Rs. 7,144.

56 Q. Suppose there were many applications, that might mean delay?—Yes.

57 Q. (The President.)—Is there any complaint of the rate of interest—6½ per cent.?—There is no complaint, but I believe it would be a great inducement if the interest were reduced.

58 Q. Do you think there would be a large increase in the number of wells if greater facilities were given?—There would be a certain increase, but not very much; they want it to supplement the *rabi* cultivation, not the *kharif*. If a perennial canal were made, there would be no necessity for extension of well irrigation.

59 Q. It would not do to make the Mohanwah into a perennial canal?—I am afraid it would be very difficult to build a weir there; it would be a good thing if it could be done.

60 Q. We heard the opinion the other day that the time of inundation canals has come to an end; have you any opinion on the point?—That is not the case in Muzaffargarh; inundation canals have worked very well there.

61 Q. Have you any other suggestions to make as regards the increase in the food-supply of your district? None, except the extension of canals.

62 Q. What about food for cattle; do you think there is any way of extending the pasture?—I think we should reduce the pasture; we should bring land under cultivation, and have fodder crops instead of grass.

63 Q. For sheep as well as for oxen?—Sheep are fed on the leaves of trees and on *skruks*.

64 Q. I suppose fuel is very largely burned?—Yes.

65 Q. Are there many trees in your district?—Any number.

66 Q. I suppose they do burn manure?—Yes, but ours is a very good tree-growing district.

67 Q. (Mr. Ibbetson.)—Still they burn manure?—Yes, in some places.

68 Q. (The President.)—What is the proportion of *kharif* to *rabi* cultivation?—It is half and half.

69 Q. If the inundation canals were larger, would there be an extension of *kharif*?—I think it would increase the *kharif* as much as the *rabi*; the *rabi* is the crop the people like most.

70 Q. (Mr. Ibbetson.)—Do they grow wheat?—Yes, what is said to pay the banks; indigo the revenue; and cotton to clothe the people.

71 Q. (The President.)—An extension of inundation canals could not be undertaken unless there was also an extension of wells?—Quite so; if the canals extend, the wells will increase.

72 Q. Do you think it would be a good thing for the district if money were spent in extending these inundation canals?—Yes.

73 Q. It would require a large sum?—I have put down the sum in my note.

74 Q. You think an extension of 130,000 acres would be sufficient for the wants of the district?—Yes, I think it would.

75 Q. (Mr. Higham.)—You say the area irrigated in the last settlement was about 200,000 acres?—Yes.

76 Q. What was the revenue assessed on that?—The revenue credited to Government canals was Rs. 2,27,000.

77 Q. Your area has now increased?—Yes to 333,000 acres.

78 Q. Has there been a corresponding increase in the revenue?—No, because it is mostly fixed.

79 Q. Do you know what are the areas of fluctuating assessment?—I could not say.

80 Q. What is the incidence of *chher* labour; how many men do you require?—A little over two for an acre.

81 Q. For how long?—For one day; the work goes on for 80 days.

82 Q. What do you find a man if he is absent?—Eight annas; we value a man at 5 as. 4 ps. per acre for labour cess; the value of the *chher* labour is only 4 annas, and we fine him double.

83 Q. When do clearances begin?—About November or December.

84 Q. What is the land revenue per acre?—It varies from circle to circle; the highest *nakhi* rate is Rs. 1-11 an

acre and the lowest in Ro. 1-2. The incidence of *chher* on the Chenab Canals is higher than on the Indus.

85 Q. Why?—There is more work required on the Chenab canals.

86 Q. You said that some canals run throughout the winter season?—Yes, this year there are two.

87 Q. Are there often more than two running?—I have not seen more.

88 Q. When are the other canals open?—In April or May.

89 Q. Is not a part of this district liable to floods that ruin the crops?—Only *bet circles*; the whole district is protected by embankments, and the district can be flooded only when they give way.

90 Q. In the Thal where the sand-hills are, what percentage of the villages is regarded as cultivable?—About 40 per cent. of the area.

91 Q. Do you think you could irrigate 40 per cent. in the Thal villages?—Yes; that is also the opinion of the Executive Engineer.

92 Q. To irrigate that amount, I suppose the whole area that is irrigable would have to be cropped in the year; there would be no fallow?—Very little fallow.

93 Q. It is as much as you can do to get 40 per cent. out of the villages?—Yes, with an inundation canal.

94 Q. Do these sand-hills move about much?—No.

95 Q. Have any facts been noted about them?—No observations have been made.

96 Q. What do the natives say?—They say that they remain in one place; most of them have trees growing on them.

97 Q. Suppose these inundation canals are made perennial and the working of the wells stopped by the opening of the Sind-Sagar, do you think the effect would be bad; would there be water-logging?—I am afraid the water-logging would get worse.

98 Q. You would put more water into the canals in the flood season and nothing during the cold weather?—Yes.

99 Q. What would be the effect?—It would not be very bad in the whole district, but in the low parts the effect would be bad.

100 Q. (The President.)—I suppose you could prevent that by drainage?—Yes; drainage might be a remedy; I have not any plans about it.

101 Q. (Mr. Higham.)—You have groups of canals; have the people any voice in their management?—Yes, they have committees, and they are consulted as regards clearances.

102 Q. Their functions are simply to advise the Executive Engineer or to make representations to him?—Yes.

103 Q. (Mr. Wilson.)—You said you don't think the people could manage the canals by themselves?—Yes.

104 Q. You said before British rule the canals were more or less managed by the rulers of the country?—Yes.

105 Q. When British rule first began, the people were allowed to do everything themselves?—Yes.

106 Q. What was the result?—Utter mismanagement.

107 Q. They could not get on without official help?—No; that is why the Deputy Commissioner took the canal management over.

108 Q. What was the result of that?—The management was improved to some extent; the Tahsildar was put on the canals, but still there were complaints; eventually representations were made to Government, and the management was made over to the Irrigation Department.

109 Q. (Mr. Ibbetson.)—Who made the representations?—The District authorities.

110 Q. (Mr. Wilson.)—What was the result of management by the Irrigation Department?—Very satisfactory; you can see it in the increase of cultivation.

111 Q. You have made a calculation of the result to Government, from improvements in canals, in increased land revenue during the currency of the settlement; you begin by taking as the amount to be credited to canals as Rs. 2,27,520; is it not the case that Mr. O'Brien over-estimated the amount of canal irrigation that was going on in the district?—Possibly; I cannot say for certain.

112 Q. Yes, it was very high. As regards these future schemes, you estimate that the extensions are to be assessed

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at Rs. 1-2 per acre; why is that?—That is about the rate that will be charged in the Sinawan Bet and the Alipur Chohi Sailab Circles on extended canal irrigation.

113. Q. Will the occupiers' rate mean a saving to Government?—I have said the occupiers' rates would leave a margin. Occupiers' rates are opposed to cover working expenses only, and we have left a small margin as canal irrigation.

114. Q. On what grounds have you estimated occupiers' rates?—It was decided that, whenever the occupiers' rate was introduced, it should be sufficient to cover working expenses.

115. Q. You have proposed different rates on the Indus and Chenab canals?—Yes.

116. Q. Why?—The silt of the Chenab is more fertilising, that of the Indus is poor; and at present the incidence on the Chenab is far heavier than on the Indus.

117. Q. You have proposed that the more valuable crops should bear heavier rates?—Yes.

118. Q. Hitherto on each acre of crops there was a uniform rate?—Yes.

119. Q. Are these rates that you propose equal to the rates charged elsewhere on inundation canals in the Panjab?—They are lower than in Multan and Montgomery.

120. Q. If Government makes a new canal or an extension of an old one in a new country, should the new irrigation pay such low rates as this?—Yes, an extension, not on a new canal.

121. Q. They might be charged higher occupiers' rates?—Yes, but not so high as elsewhere.

122. Q. To your estimate of the credit to Government might well be added enhanced occupiers' rates?—Yes.

123. Q. And the improvements promise more than you estimate here?—Yes.

124. Q. According to the statement here, in Muzaffargarh in the last 10 years 3,600 new wells have been made?—No these figures include old wells put into working order as well.

125. Q. How many new wells were constructed in the last 10 years?—Perhaps 2,000.

126. Q. What is the average cost of such wells?—Rs. 250.

127. Q. In the last 10 years the people of the district have spent Rs. 5,00,000 in the construction of new wells?—Yes, roughly.

128. Q. Has Government spent anything on the construction of the wells?—No.

129. Q. What benefit will Government derive from this?—About Rs. 6 per well.

130. Q. So that Government will gain Rs. 12,000 by the construction of these wells in the last 10 years?—Yes.

131. Q. How much *takavi* has been spent in the last 10 years?—Rs. 27,415.

132. Q. While the people have spent Rs. 5 lakhs?—Yes.

133. Q. You spoke about irrigation in the Thal by means of canals among the sand-hills; do any canals irrigate such country now?—Yes; nearly half the Nabri Thal of Sinawan is so irrigated and more than half the Muzaffargarh Thal.

134. Q. Is that country similar?—Yes.

135. Q. Have you had any complaints about canal water failing through the canals being choked up by sand?—Only one complaint in connection with a water-course.

136. Q. You say manure is required in the Thal; is not the indigo stalk good manure?—Yes; but they require other manure as well.

137. Q. There are embankments to keep out floods?—Yes; there are embankments on the Indus side and wherever necessary on the Chenab.

138. Q. Are they complete now?—Yes.

139. Q. Do they often breach?—No, no great expenditure is required to maintain them.

140. Q. Has the Indus moved much in any direction in the last century so far as you know?—It has moved west.

141. Q. Over a large tract of country?—About 10 miles in some parts of the country; in some places it has gone to the east a few miles.

142. Q. There has been some water-logging, has there not already?—Yes; but it is very much better; there has been none this year.

143. Q. What is that improvement due to?—Better management of the canals and want of rain.

144. Q. It is not due to drainage?—No.

145. Q. Is it possible to remedy water-logging by drainage?—Yes; but in the particular tract in which it occurred last it is almost impossible, because it is a hollow.

146. Q. You spoke about a perennial canal taking the place of inundation canals; would that increase the danger of water-logging in this low country?—I don't think so.

147. Q. Could not the perennial canal be kept out of this low country, allowing it to be worked by inundation canals only?—It would be difficult to work two sets of rates.

148. Q. Do you consider it advisable to construct regulators?—Yes.

149. Q. Why?—For the better management of the canals, extension of cultivation, and larger income.

150. Q. In what form?—In the form of the fluctuating rate that we propose to impose on the land; at the expiry of the settlement, it will result in an increase of land revenue.

151. Q. There has been a great waste of labour in the construction of parallel water-courses?—Yes, that is being remedied now partly at the cost of Government.

152. Q. Have the water-courses got masonry outlets?—Not yet; they are being built; the arrangement is that Government should build masonry outlets for the existing channels.

153. Q. What would be the result?—Better control of the water, and its spread over a larger area.

154. Q. A larger duty out of the water?—Yes, and higher income from occupiers' rates.

155. Q. Do you think that the expenditure incurred by Government on these water-courses, masonry outlets, and regulators will bring in a net increase of revenue up to 5 per cent. on that outlay?—I have no figures, but I think it should be from 4 to 5 per cent.

156. Q. Why have these improvements not been made before?—They were not thought of.

157. Q. (*Mr. Rajaratna*).—With reference to what you said about the difficulty of working two sets of occupiers' rates, what is the difficulty?—There is always complication in accounts in working two sets of rates.

158. Q. I suppose the area under each canal will be known?—The chance of error would be greater.

159. Q. That can be prevented by supervision?—Yes; perhaps so.

160. Q. On what principle are enhanced occupiers' rates charged on certain crops?—They are more profitable. It is fair to charge higher rates on the better crops and lower rates on the less valuable; that is not the sole reason, rice; takes a large quantity of water, and so has to pay more.

161. Q. In making the settlement did you reserve power to impose enhanced water rates when new irrigation works are constructed?—I don't think it is necessary; the occupiers' rates can be revised every 5 years.

162. Q. During the currency of the settlement no revision is made?—Fixed land revenue is not enhanced during the currency of settlement.

163. Q. Are occupiers' rates not credited to the canal?—Yes, they are.

164. Q. And owners' rates as well?—Yes.

165. Q. Have you any separate land assessment in addition to occupiers' rates?—I have no owners' rates; far waste land I have proposed a fluctuating water advantage rate.

166. Q. Is the land assessment where new lands are brought under cultivation also credited to canal?—Yes.

167. Q. (*Mr. Ibbetson*).—I understand that you don't consider Muzaffargarh to be liable to famine?—No.

168. Q. About the *chher* system, I understand that work begins in December and continues for three months?—There are three terms of one month each, but there are intervals between; it goes on to April.

169. Q. With regard to the alteration from *chher* to cess, why has it been necessary to change what seems the best thing for the people?—In the first place, the distribution of the *chher* system was very uneven, and, in the second, the *mohurrirs* who worked the *chhers* were very difficult to control.

170. Q. You are satisfied that it is for the benefit of the people to change the *chher* to water cess?—Yes.

171. Q. You say in your note that wells, when independent of canal irrigation, are no protection against drought, because you cannot work them profitably in a year of drought, why?—They cannot irrigate a sufficiently large area.

172. Q. Why?—The land in this district consists of a thin stratum of soil which does not hold water; if you don't water the crops frequently, they dry up.

173. Q. Do you mean that a well, to be used profitably, must have rain or canal water to help it?—Yes.

174. Q. In years when there is no rain, I suppose it is doubly profitable in so far as it helps the people to withstand drought?—Yes.

175. Q. What obstacle is there to their extension in the Thal?—It does not pay as well as before.

176. Q. Do you think want of manure has anything to do with it?—Yes.

177. Q. Do you think that a man is prevented from making a well by fear of the wet assessment that will be put on after 20 years?—No.

178. Q. Do you think the 20 years term is sufficiently liberal for exemption?—I think so.

179. Q. That does not prevent extension?—No.

180. Q. As regards wells that supplement canal irrigation, you propose measures which would lead to an extension of canal irrigation; will there be any difficulty in constructing the number of wells necessary to supplement that irrigation?—I don't think there should be.

181. Q. There has been considerable canal extension in the past; have wells kept pace with it?—The canal-irrigated area has risen faster than the wells.

182. Q. Supposing Government should adopt measures to induce people to construct wells, would it materially assist the extension of well irrigation?—Yes.

183. Q. Do you think the 6½ per cent. interest has prevented people from making wells?—No; people would have to pay much more to a baula.

184. Q. When you say that you think more liberal offers of assistance might promote wells, what are you referring to? What inducements would you offer, supposing you had power to do what you liked?—I would reduce the interest to half what it is now and would make it easier for people to get *takavi* than now; our main difficulty has been that during past two or three years there has been no money to give; and I would rule that the revenue officer should settle the matter on the spot and pay out the money while in camp.

185. Q. As regards the re-payment, the shorter that term the less is the total interest paid, is not the short term often asked for by the borrower?—Yes, people like to get rid of the debt. I should besides like to call the attention of the Deputy Commissioner to the suspension of these instalments; they are seldom given, and this works very hardly.

186. Q. You say that indigo is a valuable and extensively grown crop?—Yes; but I am afraid that it will not be valuable in future.

187. Q. (The President.)—Has any reduction occurred?—Yes.

188. Q. On account of German competition?—Yes.

189. Q. (Mr. Ibbsen.)—Have you had any trouble about the supply not coming on in time?—Occasionally.

190. Q. Is indigo kept down by that uncertainty?—Yes, to some extent.

191. Q. Your scheme would remedy that?—Yes.

192. Q. Is there any difficulty in making wells as to being sure that you will find water; sometimes a man starts a well and has to give it up?—Yes.

193. Q. Could any help be given him by the use of boring tools?—It has not been tried.

194. Q. Do you think it might help?—Yes.

195. Q. It has been proposed by responsible people that Government should themselves construct wells with the consent of the owners in private lands and recover their money by a rate on the irrigated area; do you think that scheme would work?—I don't think the people would like it.

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Witness 14.—Mr. L. H. LESLIE-JONES, I.C.S., Colonisation Officer, Chenab Canal.

Memorandum by Witness.

THE Settlement Commissioner has directed me to write a note for the Irrigation Commission, setting forth difficulties experienced in the past and suggesting remedies for difficulties felt in the present. Almost everything of general interest has already been discussed at length in the annual colonisation reports, and all that I can do now is to make a short *résumé* of the most important point. I shall necessarily confine myself to those with which the Colonisation Officer has been more directly concerned, although I am well aware that the Irrigation Department has had many difficulties of its own.

2. At the present time, provided that the land be good and well commended, all is plain sailing. The Deputy Commissioner who selects the settlers is surrounded by many more applicants than he can satisfy, only too anxious to obtain grants. Once selected, the grantees come down to Lyallpur in a thorough train, and having approved their land straightway proceed to turn on water through water-courses ready made before their arrival. If they are lazy, they can always find tenants to cultivate for them immediately; if they are energetic and bring down their own cattle for the first crop, they find abundant fodder available and at nominal prices; the demarcation of small squares presents no difficulties, and in the cold weather an army of Pathans comes down from Hazara to build their substantial villages. Their roads exist on the ground already demarcated, the settlers' sole duties in this respect being a little clearance of jungle and abstention from cultivation. Culverts are made by the Irrigation Department. As soon as the crop is harvested, the produce can be taken to grain markets within easy reach. The means of postal communication is very complete, and return to the home district is as easy as was arrival.

3. In the early days of the colony the state of affairs was very different. Little eagerness was evinced in obtaining land, and for present settlers Deputy Commissioners were often reduced to selecting heggars and bad characters. Capitalists who would now give their eyes for six squares then refused twenty. Yeomen declined grants in large

numbers, while many peasant settlers bolted home without turning a clod; and in truth the prospect was not at first very inviting. The levels taken on the Rakh Branch were not only fewer, but also less accurate than those on the Jhang and Gugera Branches, and instead of the mauza boundaries being fixed by the Irrigation Department with a view to obtaining the best possible facility for the irrigation of each, they were carved out by the Colonisation Officer himself, assisted only by a Sub-Divisional Officer of the Irrigation Department who was lent to him for the purpose. This officer also aligned the main and square water-courses, the latter being dug by the settlers themselves after their arrival. The result was surprisingly good, but the system was far from perfect, and it sometimes meant that zamindars found themselves stranded with no power of cultivation after digging their water-courses, because either owing to imperfect grading or alignment water would not flow down the channels which they had dug. A failure of this description might mean the loss of a crop, and in such a case there was nothing for it but to go home, as the capital and small stock of fodder which they had brought with them would be exhausted before they could expect to get a harvest, and if they did go home there were no tenants handy ready to take up their land. If they did succeed in getting water, even if an imperfect supply, and stayed to do cultivation, they were sorely tried by the hand of God in the shape of cholera and by that of man in the shape of the Janglis or aborigines of the Sandal Bar. These last were a very difficult problem. They had little acquaintance with the outer world except through cattle thieves on the banks of the Ravi and Chenab. They disbelieved in the possibility of the irrigation of the whole Bar by a canal, and what was worse, they resolved to do all that lay in their power to prevent it by harrying and looting the intelligent colonists whenever opportunity offered, and that may be said to have been every day. After an extended period of trouble, however, they were weaned from their opposition by kindness and great generosity combined. They are now in possession of over 3 lakhs of acres, and

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7. Another mistake, though of a different nature, was made in the Bhawann Branch, the desire for perfection introducing imperfection. Instead of running one base line for the whole length of the Branch, many rajbahs had their own base lines, and some water-courses, were similarly privileged—a system which cause considerable confusion both in original mapping and original allotments, and its traces can never be entirely eradicated. This mistake will never be made again.

Statement showing (in acres) the Areas allotted on the Chenab Canal from September 1892 to September 1901.

[illegible]

1. *Q. (The President.)*—You are Colonisation Officer here?—Yes.

2. *Q.* How long have you been here?—About 3½ years.

3. *Q.* When you came everything had practically started and was going ahead?—Yes, for 6 years.

4. *Q.* What is your previous service?—In this province only. I have never done any district work.

5. *(The President.)*—You really told us so much during our inspection this morning that I have not much to ask you. You explain in your memorandum the mistakes made to begin with and show how you righted them. I have nothing to ask Mr. Jones.

6. *Q. (Mr. Higham.)*—I should like to know the system of assessment in the Chenab colony—owners' rate, occupiers, rate, etc.?—We take a fluctuating land revenue of 8 annas per acre on the matured crop; a water or occupiers' rate varying with the crop; *malikani* 6 annas per acre, cesses 6 annas, and an owner's rate of one rupee not yet imposed, but impossible after 10 years. Cesses are, however, now recovered on the owner's rate.

7. *Q.* It is practically a canal rate and not land revenue except for the purposes of cess?—Yes.

8. *Q. (Mr. Wilson.)*—Will you describe what was done for the original residents of the Bari before the canal was introduced?—If they have been proved to be aborigines of the Sandal Bari they are compensated by receiving grants of land; half an acre for every male child.

9. *Q.* You treat them liberally?—Yes.

10. *Q.* Have they settled down to cultivation?—Very well, considering their origin.

11. *Q.* Are they prosperous now?—Yes, very prosperous, more so than before the canal came.

12. *Q.* Is no arrangement made for other residents of the Bari?—Yes.

13. *Q.* Something done to compensate the residents in the neighbourhood of the river?—Yes. The residents of the Jhang Mithar have been given 50,000 acres on the Chenab, and they are now receiving 20,000 more. The first 50,000 acres was given to individuals, but now the land available is given in joint grants and the same thing is being done for Montgomery district.

14. *Q.* You refer to land given to compensate for loss by diminution of floods and loss of grazing area?—Yes. They were partially dependent on the grazing in the Bari for the maintenance of their cattle.

15. *Q. (The President.)*—You have succeeded in turning them into cultivators?—Yes. *Mr. L. H. Jones.*

16. *Q. (Mr. Rajaratna.)*—You said there is some difficulty in getting people to take poor land. If the rate were reduced, would it be profitable and enable people to take up land?—It might, but it is questionable whether it is desirable. Some of the land is very poor, and it is doubtful whether it is advisable to give up land which would require a great deal of water, and water which could be used profitably on other land. *1 Nov. 01.*

17. *Q.* Referring to certain difficulties noted in paragraph 11 of your memorandum. In carrying out colonisation would it not facilitate matters if officers were placed under the control of the colonisation officer—the canal officer being personal assistant. The colonisation officer goes about getting settlers, inducing them to come in while another department regulates the supply?—If the canal officer were placed under the control—or acted as personal assistant of the colonisation officer, I don't think it would facilitate matters. A great deal of the canal officer's work the colonisation officer could not hope to control in any way—the professional work of the canals for instance.

18. *Q.* To what difficulties do you refer in your memorandum?—Great difficulty is often experienced through non-allotment of portions of the allotted distributaries. In such cases the Irrigation Department may be unable to run full supplies for the distributary because the watercourses of unallotted manzars speedily become blocked. I think it would be a good thing if the colonisation officer had more authority in matters connected with distribution.

19. *Q.* When you speak of failure to allot, you mean the failure is your own—the inability to find peasants soon enough to allot? The canal officer is not responsible for allotment?—No, the colonisation officer allots.

20. *Q.* If there is any delay it is his own fault?—No, it may be the fault of Government. If Government don't issue orders in time to enable allotments to be made, action has to be obtained for certain classes of settlers to be allotted land under certain conditions, and if Government orders are not issued in time it is impossible to send for them in time for certain crops.

21. *Q. (Mr. Wilson.)*—In a capitalist grant I understand the occupier's rate is recoverable from the tenant and any owner's rate from the owner. In a peasant village what is the difference between the two?—No distinction at all. In practice the tenant generally pays half the crop and half the total assessment.

WITNESS 15.—MR. E. A. ABBOTT, Settlement Collector, Jhang.

Memorandum by witness on the inundation canals in Jhang.

THERE are only two inundation canals in the district. The Uch Nalo taking out on the right bank of the Jhelum at Chuwani and watering down to Hessa Babel with a branch to Uch. It was dug by Fakir ul Hasan to Uch and was re-opened by Captain Burton. From year to year clearing work is done under the auspices of the District Board. The silt clearing is done by the zamindars themselves, the District Board contenting itself with giving temporary establishment to effect co-operation among the zamindars. The canal is in two tahsils which makes supervision difficult. The District Board has been empowered to levy water rate.

2. The Bikhawal Canal, which takes out on the right bank of the Chenab to the north of Pir Abdurrahman in Tahsil Shorkot. The result of efforts to make this a success has been neutralised by opposition from the owners of Pir Abdurrahman and want of co-operation on the part of the owners of Ahmadpur and Ranjiktot.

3. There is also a small cut about two miles long which brings water from the Chenab to outlying wells in Jhang and Mughiana: it is cleared from year to year by the District Board, which itself benefits by the water brought down.

4. Attempts have been made to throw bunds across old channels of the river and to utilize the water thus held up either by new irrigation cuts or old branches of the river

for the irrigation of land below the dam. Such bunds were successfully constructed last year in Binda Sadrana (Chenab left bank, south of Shorkot) and in Ali Khon area (Chenab right bank, Tahsil Shorkot). There are other likely spots where such bunds could be erected, e.g., in Talwain (right bank Chenab, Shorkot Tahsil) on the Bhajni Branch in Budhuwana (left bank Chenab, Shorkot Tahsil). The zamindars are extremely keen on such bunds and only require professional assistance to show them what to do. Sufficient professional knowledge is not always at the command of the Deputy Commissioner.

5. A very old bund exists on the Hothiana Branch, Chenab right bank, in Chiniot Tahsil. Until quite recently this bund was giving excellent results, but I cannot say if it was kept up last year.

6. I think that in the part of the district which lies beyond the Jhelum (the Kachi tract) and the villages to the south of Shorkot on the left bank of the river there is a reasonable possibility of extension of inundation canals.

7. Speaking from personal observation only and from memory, I think a new inundation canal could be taken out of the right bank of the Jhelum about Kot Shahir which could irrigate most of the villages down to Waseh Asthana. Similarly, abandoning the present alignment of the Uch Canal, a new canal could be taken out near Tuk which could water all the villages commanded by the Uch Canal and also those further south down to Guri Musaraja.

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8. The Bakhtrah could be improved and made to irrigate a greater extent of country.

9. A canal could be properly aligned taking out at the banil in Bindu Surbana already mentioned. Unless continued attention is paid to the present channels they will silt up. In the north of the district there is not the same possibility as the river banks are higher and old channels much fewer.

10. What is required is an officer who could devote his whole attention to the work which a Deputy Commissioner or his subordinates are unable to do. I do not think that inundation canals would do more than pay for their upkeep. But properly worked they would keep under cultivation wells which in any year of drought are deserted. The Kachi particularly, which is at present in a very precarious position, would be rendered secure.

11. The Jhang District Board—apart from its colony income, which cannot be devoted to the purpose—cannot afford the necessary outlay to start works of this nature, which, if done at all, must be done by officers conversant with inundation canal systems. An Assistant Engineer either in independent charge or under the Murairgargah Executive Engineer, with headquarters at Garh Mahranja, would be sufficient to carry out the possible schemes.

Effect of perennial canals on sailab and well cultivation.

12. The most noticeable effect has been the desertion of tenants who have been attracted to the canal. Tenants are proverbially hard to keep in Jhang District and the practice of advancing loans to tenants universal. The amount of takari thus advanced and never recovered is considerable. Attempts were made to prevent colonists from taking on Jhang tenants, but it is difficult to enforce any such order. In many cases owners who have received grants of land on the Chenab Canal have thrown their wells out of work in order to bring under cultivation their grants.

13. All zemindars complain that the canal has reduced the sailab area. This complaint is of course usually presented as a reason for obtaining a grant of land on the canal, but the fact that since the canal has been opened there has been a succession of low floods in the river makes the complaint plausible, but last year both the Jhelum and

Chenab rose in a flood as high as is remembered in recent years. Local inspection often brings to light the story of some old patriarch who remembers that land used to be flooded which now manifestly could not be inundated by the river both owing to the gradual lowering of its bed and to its change of course.

14. To the argument that the Canal Department tests prove that the amount of water taken in the flood season makes no noticeable reduction in the height of the river the invariable answer is that over a thousand villages now get water from the river through the canal.

15. I think that the canal makes as a rule no difference in the high flood season. Possibly in years in which the river flood is small, the percentage of water taken by the canal may be sufficient to exercise an appreciable influence on the height to which the river rises below the dam. In any case, where sailab cultivation is on land flooded through old branches of the river, or where jhallars are established on old branches to help the wells on its banks, some effect will generally be felt. The river will rise later and fall earlier and water will be flowing in the branch for a shorter time than before. The same will be the effect on inundation canals.

16. In the cold weather the reduction of the water in the river is very considerable. The effect of this is that some land already flooded which is ploughed and sown with a rabi crop is now unable to bring a crop to maturity for want of water. Such low lying land depends on being kept wet by percolation from the river during the winter to enable the crop to ripen. This land now is high and dry during the winter, and to bring crops to maturity wells will be required.

17. The same process of contras goes on when the river changes its course, which the Chenab is continually doing. Here too land which used to bring to maturity a sailab rabi crop cannot do so without help from a well.

18. It would be difficult to distinguish in the eye of each village how far each cause operates towards the result, but there is no doubt in my mind that the reduction by the canal of water in the river throws out of cultivation in the rabi (unless wells are constructed) land which might otherwise bring to maturity an unirrigated rabi crop.

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1. Q. (The President).—How long have you been in the Jhang district?—For three years.

2. Q. Have you had any famine experience?—None whatever.

3. Q. You have two inundation canals—both on the right banks of the Jhelum?—Yes.

4. Q. They do not irrigate in the Chenab colony at all?—No.

5. Q. What is the amount of land irrigated?—It varies very much from year to year; one, called the Veli Canal, irrigates 2,200 acres, and the other rather less.

6. Q. Your canals then are very small?—Yes.

7. Q. Is there much well irrigation?—Yes.

8. Q. How deep are the wells?—They vary very much—up to 100 feet.

9. Q. Is spring level very low?—Fairly—of course the district runs up to the Har.

10. Q. How much irrigation depends on wells?—216,000 acres irrigated by wells and canals, 6,221 other sources—520,000 by Government canals.

11. Q. Do the wells pull the crop through from beginning to end?—Yes, in the upland villages.

12. Q. Is there any cultivation on the Har?—Yes—once or two scattered wells—mostly for pasturing.

13. Q. You must have then a large area very similar to what it was 20 years ago?—Yes.

14. Q. (Mr. Ill-tson).—I take it 60 feet is the limit of the agricultural well?—Yes.

15. Q. (The President).—You say bunds are thrown over branches of the river Jhelum?—Of the combined rivers.

16. Q. Of course they are carried away every year?—Not necessarily—sometimes.

17. Q. Who make these?—Cultivators.

18. Q. There is no Government outlay?—No. They are not very expensive things but they do a great deal of good.

19. Q. The irrigation will be close to the river?—Yes, quite close.

20. Q. You have nothing to suggest for the Thal on the right bank of the river?—There is nothing to be done for it. It is a waste.

21. Q. It is land that is any good?—No. They grow good meadow there.

22. Q. Is it in the centre of the sand hills?—Yes.

23. Q. It would not be worth while spending money on irrigation?—That will depend on technical information.

24. Q. Bringing the great canal from the Indus will be very expensive?—I think it would be impossible from what I have seen of it.

25. Q. With reference to paragraph 10 of your memorandum you require, to make the canal worth constructing, a very large extension of irrigation over what you now have?—Yes.

26. Q. These areas you mention will not be sufficient?—No. In paragraph 7 I have suggested a canal should be taken out of the right bank of the Jhelum by Kot Shahr.

27. Q. Would that be a big thing?—About 12 miles long.

28. Q. Would it require a regulator?—No, I think it can be taken out of one of the branches of the river.

29. Q.—You will not require much professional help?—No. I think not.

30. Q. Do you think, even with that canal made, it would be worth while to keep an irrigation officer in the district?—I have no experience of inundation canals in other districts but I think an irrigation officer would find all his time occupied.

31. Q. I don't quite understand paragraph 12 of your memorandum regarding the desertion of tenants; do the tenants disappear altogether?—Yes.

32. Q. Please explain to me more fully paragraph 14 of your memorandum?—My meaning was that the zamindars laugh when I tell them that the amount of water taken in the flood season makes no difference in the height of the river.

33. Q. They really have a grievance?—Yes, I think so.

34. Q. The people on the inundation canals?—No. I mean in the *sailab* villages.

35. Q. Is there no remedy?—No, I think not.

36. Q. (Mr. Higham.)—You speak of the various possible extensions and improvements of inundation canals in Jhang and you say that it requires an officer's whole attention to be given to it. How will you find the money. Will the District Board pay for it or will you look to the Provincial Government or to the people themselves?—I think the Provincial Government should carry out the work.

37. Q. You would depend on the Provincial Government for assistance?—Yes.

38. Q. The extensions that are proposed from the Chenab canal will take up all the *khadir* land on the left bank of the Chenab?—Yes, practically all. A certain amount will still be left on the left of the Chenab below Shorkot.

39. Q. Is the land flooded? No. It is land which the Chenab canal could reach I think.

40. Q. The extensions you propose are all on the right bank of the river? Yes, except one below Shorkot.

41. Q. Has there been any increase in the construction of wells in the *sailab* lands during the last five years?—Yes.

42. Q. You say that *sailab* lands suffer to a certain extent on the opening of a permanent canal?—Yes.

43. Q. What facilities are given for the construction of wells. Are *takavi* advances given?—Yes, if they are asked for.

44. Q. (Mr. Wilson.)—The Jhelum river flows from the Shalpur district through Jhang district, joins the river Chenab and flows on between Multan and Muzaffargarh. There has been a considerable development in inundation canals in those districts?—Yes.

45. Q. Why is it that inundation canals have not been developed in the Jhang district? Is the country not the same?—I think it is because Jhang is an out-of-the-way district.

46. Q. Has any survey been made of the country between the Jhelum and Chenab with a view to see if an inundation canal could be constructed there?—I don't think so. There was a partial level taken in Captain Burlton's time.

47. Q. Who took the levels?—I think the District Board Surveyor.

48. Q. In the Shalpur district canals are made by private persons. Why is there no such development in Jhang?—I am not acquainted with the Shalpur district, but I think the people hang more together there than they do in Jhang where there is less cohesion among them.

49. Q. I think it is a matter of the Deputy Commissioner. Jhang has always been in the background. Has there been any noticeable failure on the Jhelum river?—There has been a certain amount of reduction in the Jhelum but no failure.

50. Q. Where has the greatest failure been noticed?—The greatest failure has been on the *sailab* circles in the Chinik taluk.

51. Q. Has there been much reduction on the Chenab after the Jhelum goes into the Chenab?—Yes, there has been a considerable amount there.

52. Q. Do you think that the reduction in the *sailab* area is due to the greater attraction of the canal?—No, I should say not.

53. Q. The reduction of the area is due to the small floods?—Yes.

54. Q. With reference to your paragraph 16 do you think that loss of percolation from the river is the chief cause—or the reduction in the summer floods?—The reduction in the summer floods makes it impossible to sow so wide an area, the land being left dry in the winter makes a much larger area dependent on well irrigation.

55. Q. A great many wells have been made since last settlement?—Yes.

56. Q. Have you given much *takavi* to enable these to be made?—No. They are made by the people themselves.

57. Q. A great many wells have been abandoned?—No. Wells are still kept at work but there has been an abandonment it is true.

58. Q. (Mr. Ibbetson.)—Are there any signs of tenants coming back?—Yes, distinct signs.

59. Q. Do you expect them all to come back?—I think they will in time.

60. Q. What reason have you for thinking that?—I think colonists have a great objection to taking Jhang tenants.

61. Q. You expect a return of prosperity?—Yes.

62. Q. You say you could not suggest remedy for the failure of the *sailab* in the riverain. Would it be a remedy to give inundation canals?—Yes.

63. Q. That would be a remedy?—Yes.

64. Q. Would it not be a remedy to grant *takavi*?—I don't think so.

65. Q. If *takavi* free of interest were granted?—I don't think the interest makes much difference. If they could get the *takavi* and had not to pay it back on a fixed date I think it would be a great inducement.

66. Q. What has Government done to help the people in the river valleys?—Given them a considerable amount of land.

67. Q. You do the selecting of colonists?—Yes.

68. Q. On what principles have you been selecting them?—I have given land to families, to zamindars, and also to Hindus who have got ancestral jagir land in these villages. I have endeavoured to let everybody who owns a reasonable amount of land in the village have a share in the grants up the canal.

69. Q. Have any remissions or suspensions for deterioration been granted?—Some revenue has been suspended; not very much.

70. Q. How do you account for that?—Because there had been a great increase in cultivation after the last settlement, and the last settlement rates were reasonably low.

71. Q. The present land revenue is lower owing to the reduced area of cultivation?—Figures for the past two or three years show it has been very heavy, but the figures for last year show that since the great flood in the Chouab last year the revenue on the amount of area cultivated was very light—but last year was an exceptionally favourable year and I think the revenue on the area likely to be irrigated by inundation is certainly a full revenue.

72. Q. The land revenue is at present fixed?—Yes.

73. Q. The people are not so badly off now as they were two or three years ago?—No.

74. Q. (Mr. Wilson.)—In the case of the people suffering from loss, setting aside the migration of tenants, do you think the grants given them in the Chenab colony compensate them for the loss of water?—They have compensated them.

75. Q. Do you think on the whole it has fairly compensated them?—Yes.

76. Q. You say in your note, inundation canals would not pay for more than their upkeep. In other districts they yield a handsome return. Do you include the revenue gained from inundation canals?—No, only the occupier's rate which would probably not greatly exceed the cost of maintenance.

77. Q. You still would get a fluctuating rate on cultivation?—Yes.

78. Q. Then you would get new land revenue on the extended irrigation, fluctuating and not fixed assessment, on account of the additional canal irrigation?—I think so, but they would still require wells.

79. Q. Why did the number of wells not increase faster—what were the obstacles?—I think partly the lack of tenants.

80. Q. Lack of labour?—Yes; I think also because it is desirable to keep certain lands for pasture.

81. Q.—Lack of capital had much to do with it?—Yes.

82. Q. *Takavi* has not been taken advantage of?—It has not been taken advantage of.

83. Q. What are the principal defects in the *takavi* rules?—The difficulty of getting *takavi*, and secondly the rigidity of collection.

Mr. E. A. Abbott.

1 Nov. 01.

Mr. E. A. 84. Q. As a matter of fact any suspension of instalment
Abbott. is almost unknown, but you have power to sanction it?—
Yes. The only cases in which I have suspended *takavi* have
1 Nov. 01. been when I found out the necessity myself without waiting
for a report from the Tehsildar.

85. Q. Do you think that the interest 6½ per cent. has
been an obstacle?—I don't think so.

86. Q. Do you think that the fear of fixed assessment has
prevented men from taking advances?—No; I am sure of
that.

87. Q. Do you think the period of exemption is suffi-
ciently liberal?—Yes.

88. Q. How far are these wells that you refer to a pro-
tection in a year of drought—in a famine year. You had

two experiences of drought. Did the wells fail?—I have
not heard anything of wells drying up in Jhang. They
continued to work as they did in other years.

89. Q. Have the people in Jhang any difficulty in making
a well. Do they ever come across a stratum which they
can't get through. Does that often happen?—I have not
heard of any such case. If they want to make a well, they
have a number of old disused well sites which are a guide,
and they either re-open the old well or sink another.

90. Q. You don't think we can do much to help them by
giving them boring tools?—No.

91. Q. Do you think the scheme for the construction of
wells in private land, by Government Agency, is worth
trying?—No; I don't think so.

WITNESS No. 16.—Mr. L. M. JACOB, Superintending Engineer, Chennab Canal Circle.

Mr. L. M. 1. Q. (The President.)—You are Superintending Engi-
Jacob. neer of this circle?—Yes.

2. Q. How long have you held that appointment?—
1 Nov. 01. Three years next 3rd of January.

3. Q. You were on the Western Jumna Canal before?—
Yes, for about seven years.

4. Q. Have you had practical experience in dealing with
famine relief?—Hardly any; I have had no famine works
under my charge.

5. Q. Have you any inundation canals in this circle?—
No.

6. Q. Have you had any dealings with them before?—I
was once in the Upper Sutlej Canal Division. I have nearly
always had perennial canals.

7. All we have seen here shows that everything is satis-
factory and there is nothing for this Commission to suggest
as regards this circle. The Jumna canal apparently touches
the worst famine tract in the Punjab—does it not?—Yes.

8. Q. We have many papers here and among them is a
very pessimistic report by Mr. Doule while S. Clement
Officer in Umballa, giving a deplorable account of the
country lying in the direction of Siran. Do you see any
practicability of throwing more water from the Jumna down
into that country; or any way of forcing what would be a
gigantic inundation canal so as to take up relief there?—I
am afraid I know nothing about the Karnal Division.

9. Q. Are you aware of the extensions which have been
made by reducing the quantity of water given out?—Yes.
By reducing the quantity of water given to villages, many
of which are over-irrigated, and by cutting them short
we manage to make the water go farther.

10. Q. Do you find much difficulty in reducing the water
given to villages which are accustomed to a large supply?—
No. They complained a little at first, but they seemed to
fall into the new régime quite naturally.

11. Q. Do you by this means really gain a large volume
of water?—Yes. When I was in D. M. Division, we had a
rabi of only 20,000 acres but after we had cut down the
supply of water and made several extensions we irrigated 2
lakhs. It happened to be a rainy year, before the drainage
scheme were in progress, and the country was so water-
logged we did not require to irrigate more.

12. Q. Was that a year of great abundance and plenty in
Hissar?—Generally speaking it was.

13. Q. Do you think if the Western Jumna Canal had
been laid out at first on systematic lines, after the style of
the Chennab Canal, there would have been any necessity for
artificial drainage?—The rainfall being 35 inches in the
Western Jumna, water-logging would have occurred in
course of time. I think there would have been some neces-
sity for opening out the main drainage lines. Even if it
had been scientifically laid out, the drainage schemes would
be required but not to the same extent.

14. Q. You say you have seen on the Western Jumna a
great improvement in the land due to drainage—land had
been brought back into decent cultivation?—Yes. It also
reduced the extent of the *usar* land a great deal. The *usar*
was the result of over-irrigation.

15. Q. Have you served in any other district in the
Punjab?—I have served on the Jumna, the Bari Doab, the
Sirhind and the Swat Canals and the Upper Sutlej inunda-
tion canals.

16. Q. On the Bari Doab is there any question of drain-
age?—Yes, there was in my time.

17. Q. I suppose the Bari Doab was well laid out at
first?—Yes.

18. Q. I suppose you restrict irrigation to a certain ratio
of the commandable area?—Yes, I think it should be a certain
ratio, but there should not be too much restriction.

19. Q. How much would you allow?—I think they
should be allowed to irrigate half the culturable area in the
year, but they are now irrigating more than that. It is
generally taken that the *rabi* is to the *kharif* as two to one.

20. Q. Do you see the same reason for restriction of the
kharif as of the *rabi*?—I think the two should be con-
sidered together. If you have a large *kharif* you would
have to restrict *rabi*.

21. Q. Would you use any restrictive measures to check
dehisi irrigation?—Not in a doab like this? I think very
likely it will be found here that the *kharif* area will equal
the *rabi* area.

22. Q. Have you had much to do with well irrigation?—
No. I have not had much to do with it except in a few
places where we replaced well irrigation by canal irrigation.

23. Q. Is not that rather a thing to be regretted than
otherwise?—I think the more they work well, the better.

24. Q. Have you heard any complaints here of the cold-
ness of canal water for *rabi* irrigation?—No. The only
remark made was in the case of a man who had a fruit
garden. His experience was that fruit gardens irrigated by
well water fared better than when irrigated by the canal.

25. Q. (Mr. Higham.)—I see the maximum area irriga-
ted by the Western Jumna Canal before the recent exten-
sions was 50,000 acres in the famine year of 1877-78 and
that this was never approached in the subsequent years.
Taking the 20 years before the opening of the Siran branch,
the average area irrigated was about 20,000 acres. Is that
about right?—Yes, I think it is.

26. Q. The annual average area on the Western Jumna
Canal was less than 3½ lakhs, but in the famine year it went
up to over 5 lakhs. The point is that for 20 years, which
included one bad famine year, the average area was only
340,000 acres, then by the opening of the Siran branch and
other extensions the area has gone up to about 700,000 acres.
How have the old cultivators been affected by that exten-
sion. Have they lost any of their irrigation?—I have not
been serving on the canal since all these extensions have
taken effect.

27. Q. When you were on the canal they irrigated a little
over 500,000 acres?—Yes.

28. Q. Was there no extension at all during that period?
—There were only proposed extensions. I got out the
Bhalot scheme, but it was hung up and I also proposed
another scheme and that was also held over.

29. Q. I want to know whether this extension has been
effected from water that was in excess of that ordinarily
taken by the old cultivators?—Yes, I think it was.

30. Q. Was it not the case that you could not get rid of
the water? You had to ask the zemindars to take it?—
We had the greatest difficulty in getting rid of it.

31. Q. Can you say whether the old irrigators have com-
plained of the short supply?—I cannot say from actual
experience, but I think they are all satisfied.

32. Q. When did you leave the Western Jumna?—In
1893.

33. Q. Just before the opening of the Sirsa Branch?—Yes.

34. Q. When these drains were opened did that have the effect of increasing the demand for rabi irrigation in the old villages?—Yes, a decided tendency to increase. They took water for land that was submerged before, water-logged or marshy.

35. Q. Were there any measures taken to restrict irrigation in the old villages when the new irrigation began?—No, not in my time. Afterwards I believe they were reduced wholesale.

36. Q. Since you left?—Yes. We were obliged to make our outlets rather small. The outlets originally had to be fairly large to get rid of the water, but the demand became very strong and the supply had to be restricted.

37. Q. What was the highest percentage of any village irrigated in the whole area?—I have not gone into the question deeply. Many of the villages irrigate cent. per cent.

38. Q. Are you keeping any record of the rise of spring level?—Yes, we have a well register.

39. Q. Has there been a rise within the last 5 years?—Yes.

40. Q. Do you know anything of the Bari Doab Canal—of the restrictions of irrigation carried out there?—No restrictions were carried out in my time.

41. Q. Some *rajbahas* of the Doab Canal only ran during the *kharif*?—Yes. We have also two such *rajbahas* in this circle.

42. Q. When do you run water in them?—We are now closing them for the *rabi*. The spring level was very high and the land was unsuitable for irrigation.

43. Q. Did the people make a fuss about it?—They complained at first, but I saw some of the villagers and they were quite satisfied.

44. Q. When were you in charge of the 1st Division?—Never.

45. Q. As a matter of fact you have had no active experience of restricting the water-supply?—No.

46. Q. (*Mr. Wilson*)—About this water-logged tract in the Karnal district. Since Mr. Douie has been there, there has been very great improvements?—I can't speak of the improvements because I have not served in the Karnal Division.

47. Q. Where there improvements in your Division?—Yes, in the Delhi Division owing to the drainage being opened.

48. Q. That reduced the water-logging considerably?—Yes.

49. Q. Is there much to be done to effect further improvement?—No. When I left the only extra work that had been done was done on application from the villagers themselves.

50. Q. A great deal of water-logging has been practically got rid of?—Yes.

51. Q. On the Western Jumna is the water level of the canal irrigated tract generally near enough to the surface for wells?—In my time it was.

52. Q. In dry years can a full demand be supplied?—In my time we could always meet demand, but now in a famine

year there have been great difficulties in meeting the demand.

53. Q. About the Chenab Canal, you think that you will be able to irrigate practically the whole area down to the rivers on both sides?—Yes, leaving out patches of bad soil.

54. Q. There is a good deal of good soil available for irrigation?—Yes.

55. Q. In order to supply water for extensions would it be necessary to reduce a large amount of existing irrigation?—We must restrict either in the area of irrigation or in the amount of water.

56. Q. You would give less water?—Yes.

57. Q. That will result in a shortage in the irrigable area?—No. We have irrigated over the project allowance by about 5½ lakhs of acres and our full extension will probably amount to 2½ lakhs of acres so that the colony will still be able to irrigate 3 lakhs over its project allowance. That means about 17 per cent. over the project allowance, or if we restrict, it would allow the old colony villages about 22 per cent.

58. Q. There would be a restriction of area cultivated in these villages?—Yes.

59. Q. It is desirable to carry out restrictions gradually?—Yes, they will be carried out gradually. The sooner the process begins the better.

60. Q. A considerable portion of the land is poor land and is it advisable to give water for these lands so long as there is better land waiting for irrigation?—Yes, but we don't know what land will be given up. It is almost time that the Civil Department did advise what portions of these bad lands are to be given up. If they settled once for all we would remodel the *rajbahas*.

61. Q. Would the remodelling be expensive?—No.

62. Q. (*Mr. Ibbetson*)—In your experience does the indiscriminate use of water on soil to which no manure is given lead to trouble?—I think it does, but I think it depends on the volume of water given.

63. Q. You see no object in restricting the supply given to soils for which manure is not available?—No, the only point is whether the water could be made better use of.

64. Q. From the irrigator's point of view do you think it would injure him?—No.

65. Q. You think that a reasonable restriction of supply is advisable for many reasons, owing to the rise in spring level and because you want to use water elsewhere?—Yes.

66. Q. Is it not very difficult to restrict the supply when villages have been accustomed to get as much as they wished?—When it is done gradually they don't feel it very much.

67. Q. Is it wise to allow people in the Chenab colony to accustom themselves to a full supply?—I don't think it does any harm in the early days of a settlement like this to be set on their legs; it makes them prosperous and better able to face the restrictions afterwards.

68. Q. Is it not likely to attract a larger population than will be able to live on the ground when you restrict the cultivation. Is there not a danger?—No, not with the progress we are making. I think extensions will come before that is possible.

Mr. L. M. Jacob.

1 Nov. 01.

WITNESS No. 17.—MR. W. P. BRODIE, Superintending Engineer, Derajat, Circle.

1. Q. (*The President*)—You are Superintending Engineer of the Derajat?—Yes.

2. Q. How long have you been there?—Two and a half years.

3. Q. What was your previous experience?—I was for four years on inundation canals in Muzaffargarh, six years on the Sirhind, and also on the Western Jumna, Bari Doab and Chenab Canals.

4. Q. Have you had any famine experience?—No.

5. Q. Will you kindly give us your views about inundation canals?—Well, the defects of the inundation canals are in the first place in the alignment of the canals themselves; they were dug on local considerations; there were no broad ideas of any kind and the result is they are badly aligned; they cross ridges and depressions so that parts are over-watered and others under-watered, thus, on the same channel, you have a certain amount of water-logging and in other places people cannot get the water they require;

this leads to great difficulty in improving canals. The other great defect is the absence of distributaries; there is only one channel, and every village that wants water has to dig its water-course; a village three or four miles away has to dig a very long water-course; there is, besides, a great waste of water and loss of command (explained on map). Some of these water-courses are very long and there is great difficulty and friction in getting water to the tail. From a canal point of view they are very objectionable, they make irrigation very inelastic; water has to be carried in these tortuous channels, on account of which irrigation is much restricted; the whole cultivation is 780,000 acres and the value of the crops 185 lakhs of rupees. Of course the burden of clearing these water-courses is very heavy; in the Multan Division the estimate comes to Rs. 8 per acre on the area irrigated by water-courses; this is a very heavy tax on the cultivator. There are other difficulties about the distribution of the supply; as long as the water-courses take out of the canal, it is

Mr. Brodie.

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Mr. Brodie. impossible to distribute the supply efficiently, because if you want to give these people a proper share you must do it by a stop dam (map referred to) that means a number of stop dams.

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(*Mr. Preston* explained that sometimes eight water-courses run parallel to one another; these had been very little improvement carried out on the inundation canals during the last 30 to 40 years though there had been great extension of irrigation.)

6. *Q.* You have shown us a remodelling scheme which has been completed; have you got any estimate of what is the cost per acre?—We have not made that out, because the great bulk of the work was done by *chher* labour.

7. *Q.* Are there *pakka* heads to the water-courses?—If we are to build water-course heads on the main canals it will be very expensive.

8. *Q.* You don't often put up temporary bunds?—Yes brushwood bunds.

9. *Q.* Is any remodelling scheme before Government?—We are getting one out, it is all but finished.

10. *Q.* I suppose there is no want of water?—No.

11. *Q.* Now will you please continue what you were saying regarding the defects of inundation canals?—The cure for these defects would be distributaries that would take out where the canal passes the ridges. Another point is with regard to the distribution of supply—if you have distributaries you can close them without trouble, you don't interfere with the private water-courses; at present we are constantly interfering with them and this causes an enormous amount of friction; if we had distributaries we could shut off supply by closing the distributary and we could hold up supplies by dams just below the off-takes.

12. *Q.* Have these canals got *pakka* heads?—Yes.

13. *Q.* Is there much expense in silt clearance at the heads?—No, it depends on the position of the heads; some year the river changes its course and begins to erode and silts the head.

14. *Q.* Why don't you have one trunk canal?—That is exactly what we propose to do (matter explained on map).

15. *Q.* Almost the necessary consequence of your proposal would be a weir close to the Suttley?—I don't think that is wanted.

16. *Q.* If the river suddenly dropped and threw out your works?—If you had a bad year nothing could help you.

17. *Q.* Do you think money spent on a weir is an insurance worth paying for?—That is a question of finance.

18. *Q. (Mr. Wilson.)*—Is the area commanded sufficient to pay for a weir which would serve both sides of the river?—I shall think that out; a weir means that you must have one canal for the whole area.

19. *Q. (Mr. Higham.)*—There is the danger of having your current?—That is possible enough (explained on map).

20. *Q. (The President.)*—What is the rise of the river above the minimum?—(Diagram shown to Commission by Mr. Preston.)

21. *Q.* These inundation canals begin to run in May?—At the end of April and beginning of May.

22. *Q.* And go on till when?—The first week of October in a favourable year, this year they did not go beyond September.

23. *Q.* Is that your experience in Dera Ghazi Khan too?—Yes, it really depends on the kind of year.

24. *Q.* We have got evidence of some inundation canals going on till Xmas?—Some canals with a favourable head go on all the year round, in Murfagarh canals have run for three years in succession; in Dera Ghazi Khan for two years in succession; they must be favourably situated and free of silt.

25. *Q.* Is the Lower Bari Doab scheme welcome here?—It won't interfere with our canals.

26. *Q.* How is the *rabi* crop matured?—They simply flood the land at first, after it is soaked they plough the land up and that gives them sufficient moisture with the aid of well to mature their crops.

27. *Q.* Is this country thoroughly supplied with wells for taking up the work begun by inundation canals?—All the canal land is supplied with wells; they would not take canal water except on well-irrigated land.

28. *Q.* Have they sufficient wells to give water to all that has been already entered by a canal; because a well does not irrigate more than 12 acres?—Yes.

29. *Q. (Mr. Ibbetson.)*—I suppose the spring level is not very low?—No it varies from 20 to 25 feet.

30. *Q.* What area can a well irrigate by supplementing canal water, if it gets a good start with canal water?—It would probably be more than 25 acres.

31. *Q.* There is, I suppose, a very fair amount of *rabi* irrigated?—Yes, a very fair amount.

32. *Q. (The President.)*—We had evidence the other day from Mr. Merk, who said that he would like to see a perennial canal in Dera Ismail Khan. What do you think of it?—I don't think a perennial canal in Dera Ismail Khan would be a good thing. The country there is below flood level, and if you had a perennial canal it would water-logging the country. An inundation canal would be good thing.

33. *Q.* Is there land in the Trans-Indus sufficient for extension of inundation canals?—Yes. We have projects for extending them (explained on map).

34. *Q.* A large proportion of the Dera Ghazi Khan district is watered by the Indus?—Yes, the torrents also irrigate, but in some years they get hardly anything at all from them. In the famine year the torrent irrigation completely failed.

35. *Q.* What is the proportion of torrent irrigation—is it half and half?—No. The torrent irrigation is not nearly so important.

36. *Q.* Do you know Dera Ismail Khan?—No, but I know there is a survey for improving canals there.

37. *Q.* In Dera Ghazi Khan is there much that ought to be done as regards torrent canals?—There is no real torrent canal. The cultivators bund up the torrent and take out channels on either side for irrigation.

38. *Q.* And do you think it is desirable you should have nothing to do with the management?—I think they are well managed as it is.

39. *Q.* We are told that in Dera Ismail Khan they have certain perennial streams?—Yes. What we really want is money to put in distributaries. We can't build water-courses until distributaries are made.

40. *Q.* What is the estimate for these?—I could not tell just now. In the Multan district alone we shall want 700 to 800 miles. We shall want a lot of money.

41. *Q.* Is it a question of 50 lakhs?—Something like that would be very usefully employed. I can't give any answer until we have the projects.

42. *Q. (Mr. Higham.)*—Does the area of *rabi* irrigation depend on the date on which the canals close or on the maximum rise of the floods?—It depends mostly on the height of the floods.

43. *Q.* You may have a larger area if there are favourable floods?—Yes. They take two or three waterings. In fact they will take as many waterings as they can get till September.

44. *Q.* Have you ever considered how far the extent of the *rabi* area depends on the date of closure. Can you work out figures?—No.

45. *Q.* In the Dera Ghazi Khan district Mr. Merk suggested a project for taking all the inundation canals up in one big canal taken out above the Manawah canal. Has that ever been considered?—No. I don't think so. I have never laid anything about it. I don't know whether the country is suitable.

46. *Q. (The President.)*—Mr. Merk proposed to come out below the Tank torrent.

47. *Q. (Mr. Higham.)*—Do you know anything about the proposals for Mazaffargarh?—Yes. They have been worked out by the Engineer officer. The Shanzawar is one project and is practically ready and so is the Mohanwah. The others are in danger of being thrown out.

48. *Q.* The Settlement officer made his proposals after consulting the canal officer?—Yes.

49. *Q. (Mr. Wilson.)*—In the case of these inundation canals in your division has Government spent any capital on them?—Yes.

50. *Q.* About how much?—In Multan the capital account has been entirely abolished—it is all recharged to revenue. The account did not in any way represent the value of the canal or the work on them and is quite nominal.

51. *Q.* Is the amount of the capital spent by Government since we took over this country, on these canals any large sum?—No, but on improvements it has been a large sum.

52. Q. Government derives a very large income from these canals?—It gets about 4 lakhs.

53. Q. In the form of land revenue?—Deducting working expenses that is the net revenue.

54. Q. And what is the gross revenue?—It is very large. The gross assessment is very nearly 15 lakhs.

55. Q. Fifteen lakhs derived by Government from expenditure very little of which has been subscribed by Government itself?—Yes.

56. Q. Can you tell what amount Government has spent towards the maintenance and improvements of these canals?—The net revenue out of these 15 lakhs is only about 4 lakhs.

57. Q. Government then pays about 11 lakhs a year?—Yes.

58. Q. In the case of the distributaries they have been making 14 that paid for by Government?—Yes. The improvement works are paid for by Government.

59. Q. Will Government derive any benefit?—Yes; from the increase of irrigation.

60. Q. Have you worked out what the probable profit will be on the present expenditure?—No.

61. Q. It will be a large sum?—It may be a fair sum but not a large one. The great benefit will be to the people themselves.

62. Q. You spoke of something like 50 lakhs being required to put the canals in hand. If Government advances that sum for capital expenditure would it get a fair return?—It would get about 6 per cent.

63. Q. Would the canal water rate revenue average Rs. 1-2-0 an acre?—Yes.

64. Q. The Settlement Officer has recommended the whole of this should be credited to the canal. Do you think that a fair thing to do?—Yes.

65. Q. If Government improves canals and extends irrigation to a new country do you see any reason why higher occupiers' rates should not be charged?—No. There is, however, one thing to be considered. The burden of irrigation is heavy on the people because they have to maintain the water-courses and it puts them to considerable expense, 1-8 or even 2 rupees per acre.

66. Q. Do you think people should make *pukka* outlets themselves?—No, we are building them at the cost of Government.

67. Q. You are not asking the people to make the outlets at their own cost?—No.

68. Q. You have not made levels?—Men are levelling just now.

69. Q. Does it cost much to do the levelling of that country?—No not much. We have very nearly finished.

70. Q. Is there any difficulty about getting money?—Yes.

71. Q. What is the reason?—No funds. The need for these works is fully recognised by every one.

72. Q. The *ekker* system is being abolished in Multan, and on the Chenab Canals it is abolished?—Yes.

73. Q. Do you have any difficulty in getting labour in place of the *ekker*?—No.

Mr. Brodie.

1 Nov. 01.

FOURTH DAY.

Lyallpur, 2nd November 1901.

Witness No 18—The Honourable Mr. SIDNEY PRESTON, Chief Engineer and Secretary to the Government, Punjab.

Memo. of subjects on which witness proposed to give evidence.

1. Will advocate the restriction of irrigation in tracts which already irrigate a very high percentage of the culturable commanded area or in which the spring water level is high in order to provide water for tracts which at present receive no irrigation.

2. Will present a special note and plans to exemplify it on the necessity for larger grants for the development and improvement of the inundation canals by the construction of distributaries, stop dams, outlets, etc., so as to bring them into line with the perennial canal system.

3. Will advocate the entire management including the measurement assessments being in the hands of this Department so as to place its Officers in immediate touch with the zamindars.

4. Will bring to the notice of the Commission the necessity for constructing more weirs on the Sutlej, Chenab, and eventually the Indus, so as to assure the early and late *kharif* waterings to the Inundation Canals, which must gradually be affected as regards date of opening and closing by the withdrawal of water for the perennial canals.

5. Will advocate the provincialisation of the Canals so that the province may have a direct pecuniary advantage in its development.

6. Will be prepared to explain, amplify or be examined on the notes already written and laid before the Commission on the existing and proposed irrigation works.

Mr. Preston.

2 Nov. 01.

1. Q. (The President.)—You are Chief Engineer of the Irrigation Department in the Punjab?—Yes.

2. Q. How many years have you held your present post?—I acted for Mr. Beresford for seven months in 1898 and have been in charge from February 1900.

3. Q. Before that time you were acting as Chief Engineer in the North-Western Provinces?—Yes, for 13 months.

4. Q. Before that where did you spend your service?—I have served on all the perennial canals in the Punjab except the Western Jammu Canal, but never on any of the inundation canals, I know them academically, but have no practical knowledge of them.

5. Q. Have you had any practical famine relief under you?—None whatever. The question of famine administration came up after the 1897 famine, and it was decided, with the concurrence of His Honour the Lieutenant-Governor, that it should be under the Roads and Buildings Branch. In some cases we give professional advice with reference to irrigation matters, but the work is in their charge.

6. Q. A large number of labourers were sent up from Hissar to Jhelum, who did that?—That was done by us; Mr. J. N. Taylor did it under the orders of Mr. Field.

7. Q. Have you any reason to regret the transfer of the famine administration to the Roads and Buildings Branch?—I think it is eminently right. I blame myself on having got rid of the famine.

8. Q. Can you speak of the other Provinces?—No.

9. Q. The only analogous one would be the North-Western Provinces?—Yes.

10. Q. You advocate "the restriction of irrigation in tracts which irrigate a very high percentage of the culturable commanded area, or in which the spring level is high, in order to provide water for tracts which at present receive no irrigation." I understand that that practically has been done on some of your canals?—Yes, I don't know whether I am at liberty to comment on a note by Mr. Wilson.

(Mr. Wilson.)—I have no objection.

Witness.—The Bari Doab is rather an instance in point. I first took up the question in 1898. It has taken three years to get the Revenue authorities to agree; there has been a very long controversy; I have all the papers bearing on it, and if you wish them put in could do so. The difficulty has always been that the Revenue authorities say "you will upset our settlements." I think they should revise them if necessary. Personally I was very glad to see the

Mr. Preston. remarks that Mr. Wilson has made in his note. I think it shows a tendency on the part of the Revenue officers to alter the procedure hitherto observed in the case of the Western Jomna and Bari Doab canals. In his last paragraph Mr. Wilson advocates practically what I do.

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11. Q. (*The President*).—What does he advocate?—He says that "where the rainfall is good or the underground water level sufficiently near the surface to make irrigation from wells practicable, canal water in the winter season should gradually be refused." That is—he advocates the withdrawal of water from one tract that is highly irrigated as in the case of the Bari Doab Canal or where the spring level is high. This is what I have been advocating for some time.

12. Q. On the Western Jomna Canal it has been done largely?—Yes; there was a great discussion when Colonel Jacob tried to carry out the extension. He was eager to push the Western Jomna Canal into Rohiakh, Hisar and Sirsa. Sir Denis Fitzpatrick said we had obligations to the Dolhi cultivators who had a prior claim to the water, and we must show that they would not lose; finally Colonel Jacob showed that the Delhi people would not lose, and I think that he has been justified in the result. On his strong recommendation very considerable extensions were made, viz., the Nardak, Bhivani, Bhilot and Petwa *Rajbahas*. I would now myself like to continue that policy and push on the Western Jomna Canal. The Canal has raised the spring level in the last 50 or 60 years and they can now work wells easily; my idea is that we should make them take to wells, revising the settlement if necessary; and that we should push on to Hisar, Rohiakh and to those parts where the wells are very deep and which are no doubt the most unprotected part of the Punjab. Just referring to Mr. Wilson's memorandum which I bring it up to date in one particular. In the first paragraph he gives the irrigation figures for 1899-1900; the area irrigated by State canals in 1900-1901 was 6,000,000 acres, that is, nearly 50 per cent. more than the previous year.

13. Q. Are inundation canals not included in State canals?—Yes, they are.

14. Q. In reducing the irrigation would you do it by reducing the size of the outlets?—No; we should do it by lengthening the *tallies*.

15. Q. With regard to what you say in your note as to the development and improvement of the inundation canals, I think this is the most important subject we shall have in the Punjab?—That is practically the question on which Mr. Brodie gave evidence. I should like to put in these maps which show the intricate system of water-conveyance that at present exists.

16. Q. Of course what you propose entails a large expenditure of money—apart from the question of improvement of canals and better protection against famine; would these improvements be re-productive?—I think the probability is that they will be. I should of course be sorry to give any guarantee.

17. Q. You don't think there is any chance of their being re-productive?—No, there is no chance of that.

18. Q. Is it desirable to keep up a distinction between the grants given to these large inundation canals and those given for perennial canals?—It is not maintained as a matter of fact. We have two inundation canals, the Lower Sohan and Para, and the Sidhnai which were made as productive public works.

19. Q. There is no distinction so long as a work is productive, whether the work is inundation or perennial?—No. These two are eminently productive works.

20. Q. You make a reference to certain canals on which comparatively small sums have been spent and which have gradually been extended for a number of years?—Yes, we want money to improve them, but it does not matter where it comes from. I would treat them liberally and even if they are not productive, I would put them on an efficient footing as protective works.

21. Q. Your paragraph 3 raises a thorny question which is not I think within our reference; I understand you to consider that the management of these inundation canals should be under the Irrigation Department as much as the management of the Chenab Canal?—Yes, and my reason is that at present on the inundation canals we are not in touch with the cultivators; if we were, we could do more to increase irrigation. If there is no objection I should like to hand in this note by Sir Richard Strachey, dated 1867; I brought it to put in if the Commission will accept it.

22. Q. Now we come to paragraph 4, you advocate the construction of more weirs?—Speaking generally that whole question has been worked out; there has been a good deal said, particularly by the Revenue officers that the withdrawal of this water for our perennial canals would affect the rainfall at the time of opening and closing the inundation canals.—It must in fact do so. In noting on the Bahawalpur system of canals, I tried to show that the probability is that we might affect the opening of these canals by ten days at each end. I think it is possible. I think the cure for that is the heading up of low supplies in order to give early and late waterings. I think it would be a mistake to give perennial irrigation to these canals. Constant canal irrigation is injurious to *khadir* lands. If they get their waterings early, so as to mature the *khadir* and put the *rabi* into the ground, they should depend then entirely on wells. My view is, taking the Sutlej, that we might put a weir at Sabnon, and another at Fazilka, above which it would be quite possible to have the Pak Pattan inundation canal; another weir might be put in at Dadan Wm. It has not been worked out, but I believe it would pay to make these weirs from loan funds. The cultivators could pay higher rates when their supply was made more certain. If we gave them water for *khadir* and *rabi*, they should pay a higher rate than they pay on inundation canals.

23. Q. Would you try so to erect your weirs that there should be a canal system on both sides (referring to map)?—Yes, that is a *sine qua non*.

24. Q. The Sabraon weir would not do for Bahawalpur?—No. (Explained on map.) I would not give any of these lands water in the *rabi*. The Khanraha canal worked during the whole of the cold weather, but I think it is a mistake to let inundation canals run in the cold weather. What I have said as regards the Sutlej would apply also to the Chenab. (Explained on map.)

25. Q. Have you considered the navigation rights on these rivers?—We have not provided for them. I have referred to this matter in a recent letter to Government. It was really an oversight that no provision was made for locks. As a matter of fact, we have not provided locks for any weirs except in connection with the Sidhnai canal; if considered necessary an addition of five lakhs would more than do it.

26. Q. As regards the multiplication of weirs, I suppose you would agree that the cost of the weirs would be independent of the size of the canals?—The cost of the weir would be the same even for a large and small canal.

27. Q. With regard to what Mr. Wilson says in his note, dated 23rd October. "This is bad finance. If it can be shown (as it often can) that the expenditure of a lakh of rupees in extending or improving an inundation canal will bring in more than 10 per cent., that lakh should be immediately forthcoming; but it cannot be got, while there is no difficulty in getting lakhs of rupees for expenditure on a perennial canal." What is your opinion?—I agree generally, but of course we cannot do everything at once. Supposing the result of the labours of this Commission was that they said we will give an enormous sum for irrigation, still we could not spend it at once; we cannot work as railways do, that is, by a million sleepers, or order so many hundreds of miles of railway track. Canals are made by *exchequer* paid in piecemeal, and there is a distinct limit to the amount that can be spent, certainly in the Punjab.

28. Q. The Financial Department would no doubt say so much the better?—Yes. There is I think a slight error at the end of the same paragraph. It is said that there is no capital account for the inundation canals; but as a matter of fact there is a capital account for the Lower Sohan, Sidhnai, Indus and Upper Sutlej canals which are all inundation canals. The Shahpur canals are divided into Imperial and Provincial; there is a capital account for the Imperial portion. The only canals for which there are no capital accounts are the Muzaffargarh and Shahpur Provincial. Up to this year, we had a capital account for the Lower Sutlej and Chenab canals, but it was so small that we have closed it. This is shown in pages 10 to 13 of the Volume of Statistics, which accompanies the annual irrigation Revenue Report.

29. Q. (*Mr. Abbotson*) The Sidhnai and Sohan were made from loan funds and their capital account is complete?—Yes.

30. Q. Of the other canals the capital account is not complete?—It is quite complete for the Upper Sutlej canals all of which were made or purchased by Government; it is also quite complete for the Shahpur Imperial canal, which were

made by Government, but in the case of the Indus canals it is not a complete capital account.

31. Q. (*The President*).—At the bottom of page 3 of the same note Mr. Wilson says "it is the duty of the State, when contemplating the construction of a perennial canal, to consider its effect upon the inhabitants of the river valley lower down, and to provide as far as possible for the maintenance of their present prosperity; one of the best means of doing this is to give them a share of the irrigation from the perennial canal." That I understand is the principle on which you work?—Yes, we will extend irrigation into the river valleys and reduce it as soon as the spring level rises; we have introduced this principle for the Chenab and Jhelum canals this year, and the test will be the rise in the spring level; this is the only test that it is possible to have. Instructions have been drawn up and agreed to by the Civil and Revenue authorities and approved of by His Honor the Lieutenant-Governor. (Copy shown.)

32. Q. Is it looked upon as a duty to see that the existing rights are protected as regards the *khadir* lands; is there money compensation?—No, I don't think as far as I know that my department does anything except in the tracts where we have charge of the inundation canals, as, for instance, the tract between the Lower Sahag and Hajiwah.

33. Q. You recognize the principle so far that you have advocated that, in the event of the Lower Bari Doab Canal being executed, it is desirable to ensure the rights of early and late waterings, and it is to meet this case that you propose to put in weirs—We have not recognized the principle in the past, but I consider it the right thing to do.

34. Q. Do you consider that supposing the sanction of the Government of India were given and funds were found that it would be desirable to go ahead with the Lower Bari Doab Canal at once?—Yes, I have advocated that we should go ahead with it this year.

35. Q. Mr. Wilson in his note says "a new scheme like the Bari Doab project should not be sanctioned until a complete survey of the river valley below the proposed weir has been made, a thorough enquiry into the effect of the opening of the canal on the river valley below carried out, and provision made for remedying, as far as possible, the injury to the inhabitants of that valley to be anticipated as the effect of the opening of the canal." What do you think of that?—I think it would be very difficult to anticipate what will be the effect; as a matter of fact we shall have to legislate for whatever happens when it does occur. It would be very difficult to anticipate what would be the effect of the opening of the new canal. I think I have shown that the opening of the Sukhind Canal has not affected the inundation canals of the Sutlej. The Revenue authorities do not agree. In any case we could not lower the beds of the inundation canals until the supply had been reduced in the river.

36. Q. You could commence with constructing the weir?—I doubt whether we should be able to anticipate what it will be necessary to do.

37. Q. As regards the Lower Bari Doab Canal?—If injury would be caused, there would, no doubt, be a moral obligation on the part of the State to provide *pari passu* for those lands which would suffer by the new canals withdrawing the supply; I think this would be advisable from an administrative point of view. I would not, if it could be avoided, injure riverain land to irrigate high lands.

38. Q. Would you abstain from irrigating the high lands because it was injuring the riverain lands?—No, even if it were impossible to compensate them I would still make a canal, because we should do greater benefit to the country as a whole.

39. Q. What would happen in such a case is, that the people would clear out of the *khadir* lands and go elsewhere?—I don't think that will occur.

40. Q. We had the other day strong pressure brought upon us to point out the necessity for a hydrographic survey of Dera Ismail Khan, with a view to putting on a more scientific basis the torrent irrigation in the Damon, and the witnesses also strongly advocated a large inundation canal like the Pabaspur Canal for the country between the Damon and the river. Have you considered that question?—I know absolutely nothing about torrent irrigation; I have never been in Dera Ismail Khan. The Imperial Government would not grant money for the survey of the canal because it was a doubtful project. The Provincial Govern-

ment have only lately been able to furnish the funds. We have now formed a party to survey the canal (explained on map).

41. Q. Would you advocate what Mr. Wilson alludes to at the end of his note, "a complete survey river by river with a view to determining what can best be done to maintain existing cultivation, to restore abandoned cultivation and to provide facilities by means of inundation canals for the improvement or extension of cultivation"?—No, I do not agree. I think it is better to take the tracts bit by bit; it would be absolutely impossible to do it at once; we should have a great mass of information which we could not assimilate.

42. Q. Mr. Wilson's first proposition is an annual grant of 10 lakhs to the Punjab. Is that the kind of thing likely to meet your case or do you want more?—I doubt if we could spend more. Speaking roughly, I think 10 lakhs is an outside figure for the inundation canals.

43. Q. Coming back to the Western Jumna Canal, would it be, as far as you know, practicable, from an irrigation point of view, to take a great inundation canal, say from opposite Karnal right across down to Hissar?—I am afraid I could not give an opinion as I do not know the levels. It is a question whether it is worth while taking only inundation irrigation into dry tracts. Mr. Word and I have discussed this question (reference made to diagrams). You don't get a supply till well on to the end of July and it is gone by September; there is a working flood for a very short period only.

44. Q. Do you know how much of the low supply is utilized?—It is all utilized. The Jumna river is not a good river to take an inundation canal out of, because there would be insufficient water.

45. Q. The information we have received so far has been to the effect that the necessity for protection against famine is greater in Hissar than any other part of the Punjab, and that there is no way of meeting it?—No, except to withdraw water from Delhi and Karnal and give it there. I don't see any other way.

46. Q. If that policy were followed, it should be applied in all justice to both sides of the Jumna?—We should get into political negotiations with the North-Western Provinces which it would be better for the Imperial Government to adjust. Under the existing arrangement we take two-thirds and the North-Western Provinces one-third of the supply.

47. Q. Can anything on a large scale be done with the Ghaggar streams?—I doubt whether anything can be done. I am also personally very sceptical of the advantage of doing anything, because at the time you most want the water the rivers are dry. In a year of famine the absence of rain causes the channels to be dry; at the time you most want the water it is not there, and when the channels are full, the water is not wanted.

48. Q. It is no use, I suppose, trying to find if there are basins in the Himalayas in which water could be impounded at a reasonable cost?—The slope is too great; I know of no place. I doubt if you could make any storage works in the valleys of the Himalayas.

49. Q. (*Mr. Ibbetson*).—Can you say anything of the billy country within the Salt Range area from Jhelum to Rawal Pindi?—Note No. 19 on page 67 of my volume of notes deals with the subject. I believe there are valleys in which water could be impounded, but they are said to yield salt water.

50. Q. Has any examination ever been made?—I don't know.

51. Q. And about the Gurgaon bills?—There is a complete note in the "notes on Irrigation Works." The general history is that they were in charge of our department up to the late seventies and then they were considered to be so small and insignificant that they were given back to the zamindars. There is a note on the subject at page 115.

52. Q. (*The President*).—Can you supply us with any figures regarding the relative productiveness of irrigated and non-irrigated land?—No, I have none at hand. The difficulty is, I think, that the output varies from field to field. Some Settlement officers have made crop experiments and published the figures, but they are considered to be absolutely valueless owing to the difficulty of striking an average.

53. Q. What is your feeling about the necessity of artificial drainage in a properly irrigated tract like the Chenab where distributaries have been well laid out?—I think drainage must go hand in hand with irrigation. In this

Mr. Presten.

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Mr. Preston. tract we have been particularly careful about reserving land for drainages.

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54. Q. On *reh* and *usar* lands have you known satisfactory instances of remodelling canal distributaries in land which had gone into a state of deterioration?—No, I don't know of any.

55. Q. What about the Bari Doab Canal?—There is no *reh* land to speak of. We have perhaps a little more experience on this (the Chenab) canal; there is a great deal of *reh* on it and our experience here has been that after five or six years of rice cultivation the land will bear a *rabi* crop.

56. Q. Did you arrive at the conclusion that the rice crop sucked the *reh* out of the land?—I am not quite sure. The practical result was that it improved the land.

57. Q. What are your views of the Sind-Sagar project as far as you have got?—Please see page 70 and following of my volume on "The Punjab Irrigation Works."

58. Q. Are there great difficulties in the way of the Sind-Sagar project?—I think that my views have been exaggerated. I am very far from saying that the Sind-Sagar project is impossible. Since I rode into and have seen the *thal*, I would be extremely sorry to recommend the Government of India to survey the country in detail; it would cost five lakhs; a reconnaissance party is just going out in charge of Mr. Ward to determine what tracts are likely to be worth irrigating; the Local Government will then be able to form an opinion as to whether the Government of India should embark on such a large project. There are large tracts that will not repay cultivation, partly on account of the sand hills and partly on account of the poorness of the soil, but I have only ridden over 150 miles of the *thal*.

59. Q. (Mr. Higham).—Have you got any cut and dried schemes for improving the inundation canals that are hung up for want of funds?—I don't think I can say that we have any hung up for want of funds. One in connection with Dera Ghazi Khan came up, but had to be returned a week ago to the local officers for further information with reference to financial prospects; that I contemplate sending to the Government of India; it is a scheme costing Rs. 5 lakhs and there are others in preparation. A good many schemes are in fair stages of advancement for submission relating to the Chenab Inundation canals, Multan Division; some are being worked out; two came to me on Monday last, they are big schemes.

60. Q. Schemes for making distributaries, etc.?—Yes.

61. Q. I understand they have not got the levels of the country?—In this matter Major Morton could help you more than I could.

62. Q. And in Muzaffargarh?—We have no schemes ready.

63. Q. There are several proposals for new inundation canals in the *Sailaba* tracts in Dera Ismail Khan?—There are only two that I know of—one in Dera Ismail Khan, and the Pak Pattan scheme.

64. Q. Are there any proposals for inundation canals from the Chenab for the *Sailaba* between Khanki and the Jhelum?—None have been proposed since I have been in charge.

65. Q. With reference to the construction of weirs for these inundation canals, what do you estimate as the cost of the weir at Hariki?—75 to 80 lakhs of rupees.

66. Q. Does that include the whole of the head-works?—Yes, training works and everything.

67. Q. (President).—And canal head-works?—Not the canal regulator; that would go to the cost of the main line.

68. Q. (Mr. Higham).—I suppose the weir, head channel, and regulator, etc., we may look upon as costing a crore of rupees?—Yes.

69. Q. And your three weirs would cost 3 crores of rupees?—Yes.

70. Q. Do you think that the works would pay?—I think so.

71. Q. Would they lead to an increase of area or increase of revenue?—To both.

72. Q. We could not get the benefit as regards canals in Native States?—Not, unless we carried out the work in connection with the States.

73. Q. Then you would make them contribute?—Yes.

74. Q. How long will it take to construct the weir at Hariki?—Five years.

75. Q. I suppose you could not construct any more weirs at the same time?—Yes, we could.

76. Q. It will take a number of years to make the four weirs?—Yes, no doubt.

77. Q. Then the inundation canals on the Sutlej will not be affected until the Lower Bari Doab is in full working order?—No, that will be in ten years; it would not in my opinion be possible to construct the Lower Bari Doab in less than that time.

78. Q. Could not meanwhile a great deal be done by improving the alignment of the distributary system on the inundation canals?—Unquestionably, that would go a long way towards meeting the case.

79. Q. I suppose weirs will have to be made eventually, but they would not have to be made until the irrigation on the Lower Bari Doab Canal is very fully developed?—I am not quite sure that it would not be remunerative to make the weirs at once. No improvements will be complete without the weirs.

80. Q. With regard to the Upper Sutlej canals, they have paid very well in the last few years (statement shown). They worked for many years at a heavy loss, with occasional profit, but from the year 1888-89 there have been a steadily increasing area and increasing profits. It appears, looking at this paper, that the financial success of these canals dates from the opening of the Sirhind Canal?—It is coincident with it.

81. Q. Can any reason be given for the fact that the canals have improved since 1887?—The only reason that I can suggest is the general improvement in the administration of the Irrigation Branch.

82. Q. Has money been spent more freely since then?—I cannot say.

83. Q. Has money been spent on improving the Lower Sohan?—On all canals money has been spent in cutting bonds and making distributaries.

84. Q. It is clear from these figures that the Upper Sutlej has not suffered by the opening of the Sirhind Canal on which the irrigation has not fully developed until 1887-88?—Yes.

85. Q. I think you made several new distributaries on the Kalora Canal?—Yes, all the canals were improved.

86. Q. My point is whether by improving the lower canals we cannot go a long way to counteracting the effect of taking off only 4,000 cusecs for the Lower Bari Doab Canal during the flood season?—I think very likely we can.

87. Q. That might be done before making weirs?—Yes, it will be all useful work.

88. Q. What has prevented it being done hitherto; simply want of funds?—Yes. We have never got the grants under Revenue heads that we have asked for; under loan funds we can get as much as ever we can spend.

89. Q. In regard to the proposal made by Mr. Wilson for carrying inundation canals to the high lands south of the Sutlej, Bikanir and Bahawalpur, would there be a great danger, if you had no *rabi* supply, of the canal being silted up?—It is an unquestionable danger; we should have to clear it.

90. Q. It would have to be cleared every year?—Yes. With a canal taking off above a weir we could not alter the position of the heads.

91. Q. Can you say whether levels permit of water being taken into the Lower Bari Doab from below the junction of the Chenab and Jhelum?—I can say positively that it could not. In 1893 I submitted a report on the subject which I shall send in.

92. Q. Can you say anything as to the feasibility of taking water from the Gugera branch of the Chenab Canal into the Lower Bari Doab?—As regards levels it is quite feasible, but it will be extremely expensive, because not only would you have to cross the Ravi river; but you would have to cross the whole valley of the Delh. The level of the water in the Gugera branch is 675, and the level of the ground at Wau Radha Ram is 610, a fall of 65 feet in the level of the country. It is a little difficult to give the information exactly (reference made to contour map). As regards levels there is nothing against it; but the scheme would work out to some prohibitive sum.

93. Q. If you carried enough water for irrigating the Lower Bari Doab, you would have to take it away from the Chenab Canal supply?—Presumably; if this were done, the

water would not be passed into the Chonab Canal but into a parallel canal which would be constructed. The Canal could only run in *kharif* without interfering with the Chonab *rabi* supply.

94. Q. As regards affording protection to the District of Hissar, you say that the only course is to extend the Western Jumna Canal. That would be done by depriving the Delhi and Karnal Districts of *rabi* watering?—It is the only way.

95. Q. That will mean not only depriving them of *rabi* cultivation, but also of sugarcane cultivation?—I don't think so necessarily. They can cultivate sugarcane from wells.

96. Q. That will increase the cost of cultivation?—No doubt.

97. Q. We would have to reduce the charge for water accordingly, if we only gave sugarcane watering in the *kharif*?—Yes.

98. Q. You would probably have to reduce the assessments on villages?—That is a revenue matter that would have to be faced.

99. Q. It is not a mere question of not allowing water for *rabi* crops; most of the villages depend on sugarcane cultivation?—Yes. The matter is now under the consideration of the Financial Commissioner as to whether we should largely enhance occupiers' rates on sugarcane.

100. Q. When the Sirsa branch was projected and until some time after it was opened, it was never contemplated to give it a *rabi* supply at all?—I believe so.

101. Q. It was one of those canals in which a *kharif* supply only was to be run, as we could not increase the cold weather supply of the Jumna; what has happened in regard to that?—As far as I know it is treated exactly the same as the other branches of the canal.

102. Q. It is an instance of failure to satisfy a dry tract by giving merely a *kharif* supply?—Yes, it was found necessary to transfer *rabi* water from the old villages so as to give a supply to the Sirsa branch.

103. Q. It is not denied that in the famine year the water in the Jumna was not sufficient to go round?—Yes, what there was, was better than none at all, but it is admitted that the canal irrigated crops were not up to the ordinary standard. On the other hand price was high.

104. Q. Are there instructions for the guidance of Canal Revenue officers for the prevention of water-logging? Yes; these instructions came out from enquiries which the Government of India made with reference to the extensions of the Chonab Canal. Personally I think the principle is sound.

105. Q. You have done a great deal to restrict the irrigation on the Bari Doab Canal?—We have done something, but no restriction has actually yet taken place because the extensions have not been made yet.

106. Q. In the villages about Amritsar what percentage of the cultivable area is irrigated?—Some villages irrigated 100 to 120 per cent. I think, of the whole commanded area of the Bari Doab Canal they are irrigating 68 per cent.; there are also large areas uncommanded. (Copy of a report on the subject promised.)

107. Q. My point is, Mr. Wilson says "here where the rainfall is good canal water should be refused. Has any practical attempt been made to do that in villages of the Western Jumna and Bari Doab canals where water is dangerously near the surface?—No, no systematic attempt has been made.

108. Q. Do you think that the operation of the *nakri parta* system tends to prevent the improvement of the irrigation?—Unquestionably it has done so.

109. Q. Has there been any withdrawal of irrigation and remission of the wet rate?—No. The figures show that the area has increased enormously. I have records in which I pointed out that the *nakri parta* ought to have been enhanced; we must have introduced new irrigation into a good many tracts and the wet assessment has not been put on, as it should have been.

110. Q. (Mr. Ibbetson).—About the irrigation on the Western Jumna Canal, that substantially is of some 60 years standing?—Yes.

111. Q. Before that there was considerable well irrigation?—I don't know if there was.

112. Q. An immense deal of harin had been done by over-irrigation during the first 30 or 40 years?—Yes, to certain tracts.

113. Q. To the greater part of the tract?—To the greater part of the tract then under command. Mr. Preston.

114. Q. Great injury was caused to the people and the soil; wells fell in and the whole tract became water-logged. Then you began to restrict irrigation and by that means you have done an immense deal of good?—Yes. 2 Nov. 01.

115. Q. Restriction took two forms; one was to restrict the amount of water to a given area and also the amount of the area to which water should be given, by limiting the supply?—I am not quite sure that there was any limitation of supply; the records show that since 1865 we have increased the supply entering the canal in both the *kharif* and *rabi*; you could not say there was a diminution.

116. Q. I mean the supply to an individual village?—No doubt.

117. Q. Did you introduce the system of allowing a village so many discharge outlets calculated in proportion to the area that you thought they ought to water?—I have no knowledge of it.

118. Q. Mr. Higham says you have doubled your area irrigated on the Western Jumna Canal in the last five years; you have not doubled your supply?—Very nearly.

119. Q. What is the average supply?—I put in a statement giving detailed figures.

120. Q. You have got to a point at which the supply is barely equal in a bad year to the irrigated area?—In the *kharif* it is quite equal.

121. Q. As a fact, in the last famine, the crops did suffer from short supply?—The *rabi* crops; I am not so sure that the *kharif* did.

122. Q. Now you propose to carry that procedure still further by taking water away from the old villages where wells can be built, in order to give it to villages and tracts where well irrigation is impossible?—Yes.

123. Q. Villagers would have to build wells or restore those that had fallen out of use in very large numbers in order to take the place of the water that you would take away from them?—Yes.

124. Q. You know sugarcane is an important crop in these parts?—Yes.

125. Q. The villagers practically pay their revenue from it?—Yes, I know they do.

126. Q. So important that it has been described by Colonel Olley as the sheet anchor of the canal revenue?—Yes, that was his opinion; now-a-days we would not so describe it.

127. Q. I want to show its importance?—Yes, it is very important, it is going on still increasing; with reference to that, some Civil officers as well as Canal officers thought it would be a good thing to restrict it, in order to save water for fodder crops.

128. Q. I understand that that policy has been disallowed?—No. Sir Denis Fitzpatrick said sugarcane hampers us very much, the question of raising rates should be taken up; it was intended to raise rates in order to restrict it and set water free for green crops.

129. Q. I understood it had been definitely disapproved?—No, the matter is now before the Financial Commissioner.

130. Q. The present rate for sugarcane is extremely low?—Yes.

131. Q. It would require an enormous increase in the rate to reduce the cultivation of sugarcane materially?—Probably it would; I am very doubtful if any increase would materially affect the area.

132. Q. Do you think it would be possible that the number of wells, necessary to cultivate the same area of sugarcane that they now cultivate, could be built and the area maintained; I see that the area of sugarcane is 80,000 acres; if that were to be irrigated by wells you would want at least 16,000 wells?—Probably more, perhaps 20,000 if it was to be transferred to well irrigation.

133. Q. Do you know any well-irrigated tract where the same proportion of sugarcane is cultivated?—I don't know any place, unless perhaps Batala.

134. Q. It is a fact that one of the first results of the introduction of canal irrigation is that the stock of cattle is decreased?—I have heard it is.

135. Q. And in other ways the whole agricultural economy of the village is modified, for instance the *Kumhar* disappear and so on?—Yes.

Mr. Preston. 136. Q. That is a strong argument, to say the least, against introducing measures such as you contemplate for restricting irrigation?—Certainly, still any extensions must be made very gradually.

2 Nov. 01. 137. Q. There is a good deal to be said on the other side of the question and against the proposal?—Yes.

138. Q. Do these considerations constitute a forcible argument against allowing irrigation on new canals to grow up to an extent which you are not prepared to maintain?—I have used it as such, in the question of the Chenab extensions. I have also suggested that it might be right not to permit cultivators to irrigate a larger area than that for which we have promised to supply water.

139. Q. When a new canal is opened the tendency is to extend irrigation as fast as possible?—Yes.

140. Q. But there are various weighty considerations on the other side such as I have referred to?—Yes.

141. Q. For instance you say that in the *khadir* the irrigation has to be reduced as spring level rises?—Yes.

142. Q. Would it not be wiser to keep your irrigation down to the level which you contemplate may be safely allowed in *khadir* lands?—I am not sure that we can restrict it to that; the difficulty in working on the basis you suggest would be that we are unable to measure exactly the volume of the water supplied to each cultivator; we have nothing except the area irrigated as a fact and the spring level as a fact—of course the perfect solution would be the meter.

143. Q. In practice cannot you do it roughly by reducing your supply?—We do it, but there may be a difficulty on the large scale on which we should have to do it.

144. Q. Would it be a good thing to aim at?—Unquestionably.

145. Q. Have you any knowledge of any attempts to restrict the use of canal water on well-irrigated lands?—Yes, we tried our best to do that on the Bari Doab Canal; we used not to give water on well lands and tried to keep wells working.

146. Q. Did you succeed?—No.

147. Q. Why?—In the first place, at that time, there was a water advantage rate which was only charged to *barani* lands; as well lands had been assessed as *chahi*, we were not allowed to charge water advantage rate on such lands, so that a man who took water on well land paid less than on *barani* land.

148. Q. On some places you have charged double on lands irrigable by a well?—Yes.

149. Q. Did that stop the use of the water?—I am afraid I cannot say.

150. Q. Was it effective while it lasted?—I cannot say.

151. Q. In 1885 the North-Western Provinces made a similar attempt and failed?—I am not aware.

152. Q. Have you ever considered the question of varying rates for water, higher at the tail of the Bari Doab Canal for example and lower at the top?—I have considered and advocated it.

153. Q. Do you see any practical difficulties?—None. I think there might be a zone rate.

154. Q. Would the objection be that two villages on either side of the zone boundary would be paying different rates?—I don't think it would matter; that is the case under the land revenue system at present.

155. Q. Only on account of differences between the considerable difference in the assessment of Lahore and villages, on other account?—As a matter of fact there is Amritsar—for instance Lahore District is assessed more leniently than Amritsar. I have recently written a note in which I have urged raising of the water rates in the former district in order to bring the gross demand of the State to the same point in both districts.

156. Q. You don't think any injustice would be felt, as between villages on opposite sides of your boundary line?—No.

157. Q. I understand that on any canal however scientifically laid out a certain amount of local damage will be done, which may be remedied by drainage—damage to individual villages, to soil by water-logging, &c., &c.?—Yes.

158. Q. Has compensation within your knowledge been given to villages that have been damaged in that way by canals?—No.

159. Q. You advocate strongly the principle that individual interests must in some cases be sacrificed in order to secure the greatest benefit to the greatest number—is it not of the very highest importance that the individuals so sacrificed should be compensated and compensated amply?—Assuredly.

160. Q. Is that principle generally observed on canals in the Punjab?—I cannot recall any instances in which compensation has been given.

161. Q. I think in the Punjab to some extent, and in the North-Western Provinces to a very great extent, the mistake was made of beginning with too low water-rates and allowing landlords to acquire in the form of rent a very large proportion of the profits of water?—Yes.

162. Q. And that practically our attempts to recover a substantial share of that profit have failed?—Yes, they have failed I believe.

163. Q. Recent policy in the Punjab Canals has tended to impose full occupiers' rates so as to leave as far as possible no undue profits to the owners?—Yes.

164. Q. The necessary leniency which you must use on first opening a canal is met by fixing full rates and giving liberal remissions?—Yes.

165. Q. Does not the Local Government receive a share of water advantage rate, and none of occupiers' rate; and are not cesses levied on the former, but not on the latter?—Yes.

166. Q. Has not a water advantage rate been imposed where you think it would have been better to impose a higher occupiers' rate and no water advantage rate?—I know it has been continually urged by Settlement officers that if they didn't impose the latter they could get nothing out of the canal.

167. Q. Within your knowledge these two considerations have complicated the question?—Yes.

168. Q. In practice at present the Punjab Government has a much smaller interest in the extension and promotion of irrigation than the North-Western Provinces, the canals in the latter province having been provincialized and not those in the Punjab?—Yes.

169. Q. You are an advocate of provincializing the canals?—Yes, because I am a Punjabi and I think the Punjab should get the benefit of their splendid property.

170. Q. How far in the North-Western Provinces is the surplus income from the extension of irrigation secured to the Local Government, and how far is it absorbed in the quinquennial contracts. Having been in the Secretariat there, I suppose you know?—I don't think I can say exactly; the last contract is an extremely complicated one, I gave the details in the Report for 1898-9.

171. Q. Mr. Laville said the canal income is kept wholly outside the contract?—That is wrong.

172. Q. It is included in the contract?—Yes.

173. Q. That means that, apart from any agreement between the Provincial and Imperial Government, by which a larger proportion may be given to Provincial on account of good management, if the Provincial Government wishes to secure to itself a share of the increased income which it has gained, it must correspondingly increase its expenditure within the term of the contract?—It must do so.

174. Q. It is not always possible to speed the money year by year. Supposing it were possible to keep the canal income outside the contract and allow the Provincial Government to fund it on the understanding that it must be devoted to canal works, would that not be a powerful stimulus to extension of canal irrigation?—I don't think it would be easier than it is now.

175. Q. I understand you find it different to get money for minor works and surveys?—Yes.

176. Q. And then the improvements on inundation canals; would it not have been possible to carry these out if the Provincial Government had had an irrigation fund out of the income which it had earned from extensions?—Yes, if they had a fund like that.

177. Q. It would be a question between the Imperial and Provincial Governments; if the Provincial Government had such a fund at its disposal would it not be a strong impetus to canal improvement?—Yes, no doubt.

178. Q. It is generally said that the indiscriminate use of water on lands for which there is not enough manure injures the soil. Is that your experience?—I cannot say that I see any deterioration of soil in the Punjab. I don't

think the crops on the Bari Doab Canal are any worse now than they were 10 or 15 years ago.

179. Q. Not on the lighter soils?—No, I have not heard any complaints, though there has been heavy over cropping. Taking also the Chenab, I cannot find that there has been any material deterioration.

180. Q. That is virgin soil. In any case have you noticed or heard of deterioration owing to the use of water where manure is not available?—No, in the Swat Valley they manure considerably.

181. Q. Do you think as an Engineer, that if you were asked by a Punjab peasant to advise him as to the location of a well, which he intended to sink, that is to say, where he would be likely to come to a hard or a soft stratum of soil, that you could give him any advice worth having?—No, not without boring.

182. Q. Do you think any Engineer in the Punjab could?—I don't know of any.

183. Q. Can you acquire that knowledge?—I don't think so without practical experience of sinking an enormous number of wells.

184. Q. Can you tell me the cost of a trial boring for a depth of say 40 to 50 feet?—Something small, Rs. 10 to Rs. 15.

185. Q. The Famine Code projects of the Punjab have been just revised?—Yes.

186. Q. Were you consulted about them?—To a certain extent. All the projects suggested by the Executive Engineers came through me and were passed on to the Roads and Buildings Branch.

187. Q. Are there any Irrigation projects included in them?—You can scarcely call them irrigation projects; there are cuts off from inundation canal widening banks of canals, in one or two cases clearing escapes on the Western Jumna Canal. I think the projects will remain on the famine programme for the next 50 years.

188. Q. Supposing you were asked whether you could suggest any irrigation works which would be of value in exposed tracts, could you do so?—The only thing I could suggest would be the digging of the Lower Bari Doab Canal; that means importing labour from famine tracts. I cannot suggest any irrigation works in any tract in which there is likely to be a famine.

189. Q. Do you know anything about the parts of the Punjab where funds are possible?—No; the correspondence on the subject is printed.

190. Q. (Mr. Rajaratna.)—You suggest that the canal irrigation should be restricted in tracts where a large proportion of the area is irrigated?—Provided the water is wanted in other tracts.

191. Q. Otherwise you would not restrict it?—There is no particular object in doing so, unless you restrict in order to prevent or counteract the effect of water-logging. Otherwise I would let the people have it.

192. Q. Suppose there are ten villages which might be irrigated, though not liable to drought, would you still give them water?—I should like to distribute the benefits of irrigation fairly over the whole of the tract commanded.

193. Q. What is the object of giving it to a place not subject to drought?—It is best to give all a fair share of the prosperity.

194. Q. How would you restrict the supply?—By reducing the size of the outlets or reducing the time for which the water is supplied.

195. Q. In the case of *kharif* would you exclude a certain area from the benefit of irrigation?—I would not exclude a certain area. I would give every tract an equal share of irrigation.

196. Q. But the effect would be to reduce the quantity of each individual?—Yes.

197. Q. Would that not affect the outturn?—No. I don't think it would.

198. Q. If a field gets a smaller supply than before won't that affect the produce?—It won't affect the gross produce.

199. Q. If I get less water won't my outturn be affected?—Yes, but somebody else will get the water.

200. Q. Still it would be at my expense. Do you think that would be fair?—Eminently fair.

201. Q. How?—You have paid nothing for it, you have invested nothing in the canal.

202. Q. I am paying the price of the water and I am not getting a proper outturn?—Then you should not be charged a water rate. Mr. Preston.

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203. Q. Supposing instead of an average crop of 12 annas I get only 8 annas, what relief would you give me?—In that particular case we should probably give you none; that is a point on which the Revenue Authorities are not quite at one; it raises the question of *kharaba* about which there has been a great deal of discussion, which is still going on; we have rules under which we give remissions in the case of total failure, but the rules don't allow for the case of reduction of outturn of crop.

204. Q. If you reduced the outturn by diminishing the supply?—Our rules don't provide for that.

205. Q. Should that not be taken into account when you propose a wholesale reduction?—I don't think the cultivator should be too grasping.

206. Q. Do you propose to exclude a certain area from irrigation?—We have nothing to do with the area; suppose your share is 9 hours, you may do as you like with the water we give you; we cannot interfere with that; if we give you enough to irrigate 75 acres and you only put it on 60 acres that is not our look out; we have no authority after the water leaves the outlet.

207. Q. It practically comes to this that by letting in a smaller supply of water to the ryot you compel him to reduce his area?—Yes, but we give it to the other man. We presume that whatever the ryot gets he will use to mature his crop and not spread it over too large an area and get an inferior crop.

208. Q. By diminishing his supply you make it impossible for him to irrigate his crop effectively?—No doubt.

209. Q. You say on certain inundation canals water should not be supplied during the cold weather, what do you propose to do with the water so withdrawn? Do you propose to supply it to other places?—No, to let it go to the rivers.

210. Q. Why?—The *kadir* lands are better for not receiving it, the whole object is to protect the people against themselves and prevent water-logging.

211. Q. Are the ryots not the best judge of that?—No.

212. Q. You said that on the Ghaggar Canal people would not take water in certain seasons?—No, on the Ghaggar canals they would not take it in a year of heavy rainfall, because they don't want it; last year was a year of splendid floods but the people did not require water.

213. Q. In ordinary years they would take it?—Yes, but in ordinary years we have not got the water.

214. Q. Have any experiments been made to determine the duty of water, to find out if the particular quantity of water allowed to a field affects the produce?—I cannot say. The Revenue Authorities have I believe made some experiments.

215. Q. You cannot tell if a particular canal is doing its full duty or not?—It is difficult to say what is the full duty. I don't think on any canals we have come to the maximum duty.

216. Q. Does not the question of outturn come into that?—I don't think we are in a position to test the outturn; the Settlement officers may have done it.

217. Q. (Mr. Wilson.)—Speaking generally, having regard to the inundation canals in the river valleys of the Punjab, has not much money been unprofitably spent, and could not the present area of irrigation have been attained by a smaller expenditure of money?—Yes.

218. Q. Can you say whose money has been wasted in this way?—I cannot say—in the old canals it was simply the labour of the cultivator.

219. Q. I don't refer so much to old canals as the canals of the last 50 years?—I cannot say.

220. Q. A great deal of money has been spent unprofitably there by private individuals or local bodies and not by Government?—I dare say.

221. Q. Could not a great deal have been saved if there had been a survey of the land and proper professional advice taken?—Unquestionably the canals would have been laid out on better lines.

222. Q. Is it not the case that the people were not in a position to get the survey done?—They could not have done it themselves.

223. Q. Is there not still a very large area in the river valleys that has not been surveyed by Government?—There

Mr. Preston. are some areas but not very large; there are some areas on which we are working of which we have not complete surveye.

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224. Q. We were told yesterday that a complete survey has not been made of the area irrigated by the Multan inundation canals?—No.

225. Q. You know something of the levels of the country in the Thal?—Yes.

226. Q. And the parts that are under survey in the river valleys of the Punjab would not take very long to survey?—No.

227. Q. You said the survey of the Sind-Sagar Thal would cost 5 lakhs?—That is a pure shot. I think the Lower Bari Doab was estimated for at 1½ lakhs; it will be certainly more than three times that, probably 5 lakhs.

228. Q. Would that 5 lakhs not be ample to complete the survey of the river valleys of the Punjab?—Yes.

229. Q. Would it not be better spent than in a survey of the Thal?—At present we are going to make only a preliminary survey.

230. Q. If you had to decide on your present knowledge?—I would not at present advocate the detailed survey of the Thal at all; and I would take up the river valley survey bit by bit as we were ready to make a canal rather than complete the whole at once.

231. Q. The money would be more profitably spent than on the Thal according to your present views?—I cannot say; if the Sind-Sagar Canal is made it might be more profitable.

232. Q. If you had a complete detailed survey of the river valleys would you be in a position to say which project should first receive attention?—I think a detailed survey would only help us to make the canal; only the Civil officers could say which was the most promising.

233. Q. Would not the Civil officer be in a better position to judge if he had the levels?—No; I think it is a question of soil, sub-soil water, etc.

234. Q. When you have to prepare a scheme for a canal, is it not the first thing to make a detailed survey of the country?—Yes.

235. Q. Is not your knowledge of the advantages or disadvantages very vague until you have the levels?—Yes.

236. Q. Also as regards the advantage of making the canal at all?—It might be most advantageous to make the canal, but the levels will not help you to decide that; they help you to decide whether a canal is possible, not whether it is advantageous.

237. Q. What is the cost of the Lower Bari Doab scheme?—33½ lakhs.

238. Q. What is the ultimate net profit on that sum?—9·7 per cent.

239. Q. How long would it be before there was any net profit?—19 years.

240. Q. If you were told that in the next ten years you would be given a crore of rupees for inundation canals as soon as you could show that on any scheme Government would receive a net profit of 10 per cent., could you not work out a number of schemes that would give that promise, either in improving the existing canals or in other schemes?—Yes. But I would not like to be tied to 10 per cent.

241. Q. And the profit would come in immediately?—We should not have to wait so long as 19 years.

242. Q. Would not the increased return from improvements on inundation canals come in almost immediately?—Yes.

243. Q. Would it not be a more profitable financial transaction to spend a crore, if available, on such improvements which would bring in a net profit immediately than on a scheme which will only bring in 10 per cent. after a lapse of 19 years?—I am not sure; there are such a number of uncertain items. Small improvements on inundation canals would bring in a quick return but what the return would be it is difficult to say; at present the rates on most of the inundation canals are so low that they do not promise well; on the inundation canals of the Indus we don't get more than 1·8 an acre, on some canals we only get 6 annas an acre. This estimate of the Lower Bari Doab Canal is based on things that we know, water rate and cost of maintenance.

244. Q. You mentioned that there were several schemes for improvement of inundation canals or the construction of new inundation canals ready?—Yes.

245. Q. If you were told that whatever money you wanted for survey in such tracts would be given at once and for

whichever schemes you could send up which gave a promise of 5 per cent. net profit, could you not prepare a considerable number of such schemes very soon?—Yes.

246. Q. And the expenditure would be financially profitable to Government?—Unquestionably.

247. Q. Is there not a considerable complication in Shahpur because some of the canals are Provincial and some Imperial?—No, I think there is no complication because they are quite distinct; the Ranivali is Provincial, the only other Provincial canals are two on the right bank of the Indus.

248. Q. I mean complication of accounts: you have to keep separate sets of accounts; it would be simpler to have them under one head?—Yes.

249. Q. You think it would be an advantage to the Province if all the Imperial canals were provincialized?—Yes; it is not so much a matter of accounts as that the Province should get a share of the benefits of irrigation, which it does not at present get.

250. Q. Do you think it is advisable to encourage the increase of private canals?—I am strongly against it.

251. Q. And of District Board Canals?—No, this is the age of specialists, and if you have a special Department to do the work it had better be done by that Department.

252. Q. You think that new canals in the lower part of the Punjab should be under the control of the Irrigation Department?—Yes.

253. Q. Imperial or Provincial as the case might be?—I think that it is immaterial.

254. Q. Is it not the case that Government should consider themselves responsible for all development of irrigation all along the Punjab rivers?—Yes.

255. Q. Might it not be advisable, as in the case of canals, that the Irrigation Department should take some account of well irrigation and develop that also?—I am not quite sure that they are in the same category as canals because you are not going to administer a well.

256. Q. We have had it in evidence that the peasants are often in difficulties as to where to make a well and how best to make it, that help could be given by the use of boring tools and expert advice as to where they could best build their wells; could not officers of the Irrigation Department give them considerable help in the matter in future?—I don't think we have any very special knowledge as to the best sites, we could make borings or sink wells for them. I understood you referred to the administering of a well.

257. Q. No, only to give what help could be given through the Irrigation Department?—Yes, certainly.

258. Q. There is no other Department of Government that could do it so well?—No.

259. Q. Talking about the effect of weirs on the river levels below, you said that by deepening inundation canals you had contemplated any effect that the weirs had on reducing the level of the water?—Yes.

260. Q. Colonel Grey said that a large sum had been spent in Bahawalpur without any help from the Local Government. Has anything been done in the same way at the cost of Government to counteract the effect upon private inundation canals or private owners of land?—Not to my knowledge; on the rivers where we have weirs there are very few private canals; there is one in Multan; our weir has not begun to act there. I don't know if the Multan owner has done anything in the matter.

261. Q. So far nothing has been done to counteract the effect of the opening of canals on the land of private owners not irrigated by Government canals; anything that has been done was at the expense of the people?—I dare say. I have no knowledge.

262. Q. About the use of the surplus water—is it the case that after the Jhelum Canal has been opened, there will still be a certain surplus of cold weather supply in the joint Chenab and Jhelum?—Unquestionably.

263. Q. Would there be a surplus in the Jhelum?—Yes.

264. Q. How do you propose to utilize that surplus water in future?—Probably by the construction of a weir somewhere at the head of the Multan District to give early and late waterings to the Chenab series of inundation canals.

265. Q. Will that utilize the whole?—I cannot tell just now; I don't know what the volume will be. The Muzaffargarh canals would be linked up. I don't know where else you could utilize it.

266. Q. Would it be a great advantage if you could supply the Sidhnai canals from the Chenab?—Yes. The Sidhnai irrigation is precarious in some years.

267. Q. If you had a weir here which held up the cold weather supply, would that not give you a supply in the Sidhnai?—It would have to go back 12 miles (explained on map).

268. Q. You said it would be difficult to take the Chenab across the Deg, could you not take it across the Ravi at less expense?—Yes.

269. Q. It is possible as regards levels, if there is spare water, to turn the Sirhind Canal into the Hissar District?—Yes, one great difficulty is the political difficulty of carrying water through Patiala.

270. Q. And also into the tract east of that?—Yes.

271. Q. (Mr. Ibbetson).—Would water be available?—Not without restriction elsewhere.

272. Q. (Mr. Wilson).—Is there not excessive irrigation in the Ludhiana District?—No, the percentage of irrigation is less than in Fazilka.

273. Q. Is not well irrigation available?—Yes. Fazilka gets a much larger percentage; there we are irrigating 37 per cent. and up above not more than 25 to 28 per cent.

274. Q. You can at all events get a certain amount of water by taking it from tracts where well irrigation is possible?—Yes.

275. Q. Would that not be a better distribution of the water—a more widespread distribution of its benefit?—Yes, I think so.

276. Q. You spoke about the Ghaggar canals in dry years drying up, and in wet years carrying water which nobody wanted. These are extremes?—Yes, but that covers every year of our experience.

277. Q. Is it not the case that the Ghaggar Canal gives you a better command of what water there is?—I doubt if it will ever be a valuable famine asset.

278. Q. In course of years you will be able to make better use of it, and it will no doubt be a considerable protection against famine?—Yes, whatever water there is will be made better use of.

279. Q. You have had some experience of counteracting water-logging. A good deal of advance has been made in several tracts?—Yes.

280. Q. It is not impossible to remedy water-logging?—No. In Karnal and parts of the Bari Doab a good deal has been done.

281. Q. On the Chenab Canal there are about half a dozen different rates, you are in favour of consolidating these rates?—Yes.

282. Q. You are in favour of differentiating the rates according to the qualities of the soil?—Yes, unquestionably.

283. Q. At present we have the same scale of occupiers' rates throughout the whole of the canal area?—Not quite.

284. Q. The occupiers' rate is a very low one for good soil?—I don't think so.

285. Q. The total demand is low?—Yes, it is low I think for the best soil.

286. Q. There are considerable blocks of land on which a higher rate is possible?—Yes.

287. Q. What is the effect of cultivation on poor soil and having a high rate for the use of water?—We are having difficulty in getting this poor land taken up.

288. Q. And the result will be that a considerable area of poor soil will not bear the cost of cultivation?—Yes.

289. Q. The value of water is greater on good land than poor land?—Yes.

290. Q. Is it not very advisable to first irrigate what good land is available and then afterwards to try as far as you can to reach the poor land?—Yes, certainly.

291. Q. You have quoted from a report written by Colonel Strachey in 1867. Is it not the case that in those days the management of the canals was in the hands of the Revenue officers; they managed the *ekher*, they worked the canals and the irrigation officer had no control on these inundation canals?—I think that he had the same control as he has now—it is a matter of history. The management is not now wholly in our hands.

292. Q. Not in Muzaffargarh?—We didn't get charge of them till 1880. In the Indus canals I don't think there has been any difference.

293. Q. Is it the case that the management of these canals is entirely in the hands of the Irrigation officers?—We simply allow the water into the canal, but don't know where it goes.

294. Q. You manage the silt clearances?—But not the distribution of supply.

295. Q. What Colonel Strachey wanted to do has been done since 1867, is that not the case?—I am not aware that there is any difference. I think the canals would be more efficient if we were in touch with the cultivators.

WITNESS 19—MAJOR W. R. MORTON, R.E., Executive Engineer, Multan.

1. Q. (The President).—You are in charge of the Multan Inundation canals?—Yes.

2. Q. How long have you been in charge of them?—Nearly four years.

3. Q. I think the point you propose to give evidence on is that there are certain faults with regard to the canals that should be remedied?—Yes, chiefly with regard to the length of the water-courses.

4. Q. Has that affected irrigation injuriously?—Yes, there is a great loss of water; it would be better if you had distributaries to distribute the water on both sides, instead of long direct water-courses from the main canal.

5. Q. You say the proposed Dardn lagana scheme of remodelling would increase the irrigated area?—Yes, undoubtedly.

6. Q. Considerably?—I don't know exactly how much.

7. Q. What sort of percentage would you get on the cost of the scheme?—11 per cent.

8. Q. (Mr. Higham).—Have you got any remodelling scheme?—That is one.

9. Q. Have the details been worked out?—Yes.

10. Q. You could go ahead at once, if you had the money?—Yes.

11. Q. Are there other schemes which are feasible in the Multan District?—Schemes for the whole district could be worked out.

12. Q. This is the only one that has been worked out?—Yes.

13. Q. When was it worked out?—About two years ago; it is very old; it dates originally from 1884.

14. Q. So far as you can judge, will the other schemes for remodelling pay as well?—I don't think they will pay as well.

15. Q. Do you think they would pay half as well?—They would pay 8 to 9 per cent.

16. Q. What are the benefits?—Increased area.

17. Q. And a larger duty from water?—Yes, half the water is wasted just now.

18. Q. Has each village its own water-course?—No, some of these water-courses serve several villages.

19. Q. You have no record of the irrigation from each water-course?—No.

20. Q. Is the management in your hands entirely?—Yes.

21. Q. Do the District Boards finance the canals?—No; they simply build bridges; they get no income.

22. Q. (The President).—Have you any experience of District Board management?—No.

23. Q. Are canals kept clear by *ekher* labour?—No; that's been abolished.

24. Q. When was the change made?—This year on two canals.

25. Q. The change was made in your time?—Yes.

26. Q. Why was the change made?—It was an antiquated system.

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27. Q. Have you had actual experience of working the *chher* system?—Yes.
28. Q. How did it work?—It created a great deal of trouble, because people were continually absent.
29. Q. Were there such difficulties that on their account it was advisable to substitute a water-cess for *chher*?—Yes, but probably the chief reason for abolishing it was to get money to improve the canal. Under the *chher* system we could not get the labour for improvements; we could not well use the labour of one water-cess for improving another.
30. Q. Do you think the change was popular?—I have never heard any complaints since the change was introduced.
31. Q. (Mr. Higham.)—How long have you been in this Division?—Nearly four years.
32. Q. The Sidhnai Canal is in your division?—Yes.
33. Q. You were in charge during the two disastrous years?—Yes.
34. Q. What did your irrigation fall to?—28,000 acres.
35. Q. How much *khara* had you in 1898-99?—I think 80 to 90 per cent.
36. Q. Who assesses this *khara*?—The Civil authorities; there is no check by the Canal establishment.
37. Q. I think there was a condition that these villages in the Sidhnai should sink wells?—Yes.
38. Q. How many wells irrigate in a dry year?—They would, but there are not very many.
39. Q. Have they made wells to the extent they were required to?—No.
40. Q. What was the rule?—I don't think there was any rule laid down.
- Mr. Wilson. I think there was.
41. Q. (Mr. Higham.) Have you any figures to show the number of wells?—No.
42. Q. How did the people themselves like the substitution of water-rates for the *chher* system?—When it was first going to be introduced the people said they did not like it; now they take it quite quietly; they like it on the whole; they say the canals are likely to improve under the new arrangements.
43. Q. Was it not a fact that on the Chenab canals there was a very high percentage of absentees on the *chher* system?—Yes.
44. Q. What is the slope of these canals?—1 in 10,000; it goes up to 1 in 6,000.
45. Q. Is 1 in 10,000 the general slope?—Yes.
46. Q. (Mr. Wilson.)—Did you carry out any clearances last year by cash payments in place of *chher*?—We took up two canals to begin with.
47. Q. Last winter had you any difficulty in getting labour?—Not this last.
48. Q. Do you anticipate any difficulty this winter?—None; we will begin much earlier.
49. Q. One disadvantage of the *chher* labour is that you could not get clearances finished in good time?—Yes.
50. Q. Were the clearances generally finished by the 15th of March?—Not generally; after 40 days you could not call on the *chher*.
51. Q. As a fact were the clearances generally finished in good time?—I think the first year I had charge of the canal we had some delays, but not much.
52. Q. Under the new system won't you be able to finish clearances much sooner?—Certainly, by the beginning of April.
53. Q. And if it were desirable to open canals earlier you could clear them earlier?—I don't think you ever want to open them before the last ten days of April.
54. Q. You say you estimate the net profit of this remodelling scheme at 11 per cent.?—Yes.
55. Q. In estimating the income you expect to have a large area of irrigation?
56. Q. Is it not the case that the present occupiers' rates which are charged are fixed low as merely a maintenance rate?—Yes.
57. Q. Is there any reason why the area which will now be irrigated for the first time should be assessed at this low occupiers' rate?—No, except that there might be difficulty with two rates.
58. Q. The occupiers' rates have been fixed not for the term of the settlement, but can be revised at all intervals after five years?—The Government of India said they probably would be revised after five years.
59. Q. There is no reason why that new area should not pay the higher rate?—You would have to do it on the whole canal.
60. Q. The construction of this distributary will reduce the expense of maintenance?—Yes.
61. Q. So even the old irrigation might be charged a higher rate?—Yes.
62. Q. It would be fair to do so?—Yes; the land-revenue is fluctuating and the new cultivation will be assessed.

Note.—The Fifth and Sixth days' sittings were held in Siod.

SEVENTH DAY.

Lahore 8th November 1901.

WITNESS 20—The HON'BLE Mr. J. M. DOUIE, I.C.S., Officiating Chief Secretary to the Government of the Punjab.

Memorandum on irrigation and drainage questions in Umballa and Karnal.

Mr. J. M. Douie.
8 Nov. 01

Introductory.—I was Settlement Officer of the Jagadhri Tahsil of Umballa and the Thanesar and Kaithal Tahsils and the Indri Pargana of Karnal from the end of 1882 to the beginning of 1899. The Thanesar Tahsil of Karnal was then part of the Umballa District and was known as

the Pipli Tahsil. Since 1899 I have had no official connection with either the Karnal or the Umballa District, and this fact must greatly lessen the value of any information which I can give to the Commission on the subject of this note.

2. General description of tract.—I wrote in 1884 a note*

* Printed in Punjab Government, Revenue (Irrigation), Proceedings, No. 7 of May 1895.

on irrigation from hill streams in the tract which I was then settling, in which I dealt with the action of seven streams—the Som, Rakshi, Chautang, Sarusti, Markanda, Umla, and Ghaggar. The first four traverse the Jagadhri Tahsil, and the whole course of the Som, which flows into the Jumna, lies in that tahsil. In Jagadhri the hill streams do more good than harm, and produce no water-logging. We are only concerned really with the action of the streams in the great plain which stretches to the south and west of the North Western Railway, which runs from Sahranpur to Ambala parallel with the hills and at a distance of 30 or 40 miles from them. I venture to quote a description of this plain which I wrote in 1891:—"To the south and west a great plain of stiff loam and hard rice land stretches away towards the mid Harijans and Bagar tracts of Hissar and the Jangal country of Patiala. Going southwards and westwards the rainfall becomes more and more scanty and uncertain, and the water-level sinks rapidly, till in the south of Kaithal the yearly fall averages only 16 or 17 inches, and water is reached at a depth of 130 feet. With severe labour and the help of expensive wells, *indiana* *sons* *work* *well* *where* *the* *water-level* *is* *as* *low* *as* *50* *or* *even* *60* *feet*. Where it falls still lower the sturdiest peasant finds that irrigation will not pay, and the harvests depend on what the heavens send them. Under these circumstances the crops consist in the kharif of millets and pulses, and in the rabi of rape and gram. The people look much to their cattle for their means of livelihood, and in good seasons the pasture is abundant. Where the rainfall exceeds 24 or 25 inches the cultivable waste is covered with strong *dhak* jungle, and where it is less, with a sparser growth of *jand* and *jal*. The whole of this thirsty plain is liable to severe droughts, the harvests are most precarious, and failure reaches the level of famine every seven or eight years. Herds of starving cattle are driven off to the Jumna and the Siwalike. Many die there, and the mortality among those which remain behind is enormous. In the north indeed the Chautang, the Sarusti, the Ghaggar, and the Umla in its lower reaches after it has dropped its fertilizing silt, overflow part of the plain in the rainy season, but the floods are most capricious, and the inundated tracts fluctuate between drought and drowning, while their population is scourged with fever and pneumonia, and between disease and uncertain harvests, is in a very depressed condition. The uplands lying beyond the flooded zone are healthy, and have a sturdy and not unprosperous population." A large part of this plain is known as the Nardak or moricless country. The name is popularly supposed to have been given to it on account of the cruelty of its inhabitants, a quality which I never noticed in them. It may be more appropriately applied to the intractability of its soil and the precariousness of its harvests. During the four years that I observed the harvests of the large Nardak Circle in Kaithal the area on which crops were harvested varied from 24 to 93 per cent. of the recorded cultivated area, the average being 53 per cent. The figure of 24 refers to the year 1893-94, which was one of great drought. Between the beginning of June 1893 and the end of September there were less than six inches of rain, and one-half of the whole fell in the first fortnight of September. In the Nardak the sowings were far below the average, and 62 per cent. of the kharif crops sown failed. From October to the end of March less than an inch of rain fell. There was no rabi harvest except in a few estates in the extreme south, which are watered by a branch of the Western Jumna Canal, and in a few villages on the northern edge of the circle which have workable wells. A failure of spring crops would have been little regarded, if there had been rains and water for the cattle. But the failure of the summer rains caused a grass famine and the kharif yielded no fodder. All the tanks dried up. The cattle were driven off in large numbers to the lowlands along the Sarusti, to the Ganges valley, and to the hills, and many never returned. The condition of the Nardak has been immensely improved since I settled Karnal-Umballa by the construction of the Sirsa Branch of the Western Jumna Canal and of the Nardak Rajbaha. The part of the bed of the Chautang stream which traverses the Nardak to the south of the Sirsa Branch has also been canalized.

3. *The Som*.—Of the seven streams which I have mentioned the Som lies to the east of the watershed which separates the valleys of the Jumna and Ganges from that of the rivers which find their way into the Indian Ocean. It is a wide sandy sho, but owing to the conformation of the

country does not penetrate far into the plains before it falls into the Jumna. Its silt is good, and its floods on the whole very beneficial. The Emperor Akbar once ordered it to be diverted into the Chautang, but though their head waters are not far distant from each other it is doubtful whether modern Engineers would attempt the feat, which Lieutenant (afterwards Sir Henry) Durand long ago pronounced to be impossible. The Som when in flood gives a good deal of trouble to the Engineers of the Western Jumna Canal.

4. *Character of other streams*.—The other streams lie to the west of the watershed, and the waters of three of them, the Sarusti, Markanda, and Umla, find their way into the Ghaggar, which finally loses itself in the sands of Bikaner. The Rakshi and Sarusti are drainage channels originating in the plains at some distance from the hills, the other streams rise in the hills. All streams of the latter class in the Karnal and Umballa Districts begin as shallow and fairly wide sandy channels and end in narrow canal-like clayey beds. During the first stage their action is very beneficial from an agricultural point of view. The silt spread over neighbouring lands when frosts come down is fertilizing, and no marked harm is done to the health of the population. The passage from a sandy channel to a clayey one marks the point where the stream has dropped all its silt, and henceforth it hardens instead of softening the soil which it overflows. The water even without silt is of course immensely valued in a country with a scanty and extremely uncertain rainfall, and an intractable soil. The villagers on the banks block up the bed of the stream with bands to force the water over the land, and, if necessary, put up embankments to prevent its escape down side channels in another direction. The bands tend to produce silting up of the main channel which sometimes almost disappears. The side embankments are cut round and have to be enlarged from time to time till we get such elaborate works as existed when I was Settlement Officer on the Sarusti at Mangna and Galedwa. The obstruction of the natural drainage of the country by bands and embankments prevents the floods being carried off rapidly. The stiff soil absorbs water very slowly, and great marshes are formed in depressions, which last far into the cold weather. The above description applies specially to the Sarusti.

5. *Rakshi and Chautang*.—The Rakshi and Chautang are described in the note which I wrote in 1894 and in paragraphs 11 and 12 of the Karnal Gazetteer. No useful purpose would be served by repeating that description here. The canalization of the Lower Chautang has been only recently completed. I have no information as to how the Chautang Canal has worked up to date, but the southern part of its channel was practically useless in my time, and any irrigation from it will be pure gain. The work was estimated to cost about two lakhs. If it is desired to increase the supply of water in the Chautang this could probably be done by putting up sluice gates at Sultanpur near Ludhiana, where the greater part of the water is diverted into the Sarusti. There is an old decision regulating the division of the water at this point, but it has never been enforced. I believe the Irrigation Officers have taken levels of the country traversed by the Rakshi and Chautang near Ludhiana.

6. *The Sarusti*.—I quote from the Karnal Gazetteer a description of the Sarusti as it was 12 years ago when I was Settlement Officer. Since then the Sarusti Canal to be presently described has been dug:—

"The Sarusti, the most sacred river in Northern India after the Ganges, does not rise in the hills, but begins in a large depression in the north of the Mustafad Pargana of Jagadhri. For the first 20 miles of its course it is insignificantly insignificant, its channel being frequently only marked by a shallow depression on the surface of the ground, and being often lost entirely. Like the Brahmans who grade on its sanctity, it lives on the contributions of its neighbours. It is only after a branch from the Chautang joins it at Bhaini that it acquires a continuous channel, and is worthy of being called a stream. The Chohn, the Botun, and the Linda, which are probably old channels of the Markanda, join, and the united stream, known as the Linda, falls into the Sarusti near the border of the Karnal District. A few miles lower down at Unai the Markanda pours its waters into the Sarusti. The channel cannot contain the heavy Markanda floods, and in the rains the country to the east of Pehowa is converted into a great lake. At Pehowa the channel again becomes well defined, and thence it runs west and south-west to the border of Patiala. At Galedwa near Pehowa a large dam diverted the water into the Bidkiarwala Kband, a channel originally dug by Bhui Lal

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Singh to feed the sacred Bidkhar tank at Kaithal. This embankment, which did much damage to the Lower Sarasti villages, was opened a few years ago. At Gulderna a branch known as the Baha strikes off to the south-west, and its water is prevented from returning to the main channel by a strong earthen dam, or rather series of dams, erected at Mangna, and forced over the lands of the Naili villages in the neighbourhood of Nawach. The old bed of the Sarasti has become silted up at Gulderna, and is 4 or 5 feet above that of the Baha, the size of which has increased of late years. The Baha now takes all the water in small floods. The result is that the seven or eight Baha villages seldom lose their spring harvest, but the people inhabiting them are rapidly dying out from the effects of over-flooding. The Lower Naili villages, on the other hand, do not get their fair share of the water except in good years when every body has as much as, or more than, they want. At Kake-nar, a few miles lower down, an important channel takes off to the north-west and fills the great jhil between Papsar and Kakhari. The overflowings of this marsh run down a shallow bed known as the Nal Nadi into another large jhil in the south of Bhuna. This is its turn spills in high floods into the Phara, which will be noticed presently. The main channel continues to run westward and passes through the north of the great Rajput estate of Siwan, for the irrigation of which an important embankment known as the *Belak baad* is thrown across the bed of the stream.

At Sair, a mile or two lower down, a branch called the Phara breaks away to the north-west and, after following a winding course for ten or twelve miles, leaves the tahsil at Khorak and soon afterwards falls into the Ghaggar. The bed of the Phara at its mouth is not large, but, besides the water taken direct from the Sarasti, it receives the drainage of the whole valley to the north of that river, and, before it quits the tahsil, it is a very deep and wide stream of the same character as the Ghaggar itself. It has become much larger since last settlement, and is now in fact the main channel, and in high floods is a violent torrent which it is very difficult to control. Ten or eleven of the Naili villages depend on the Phara, and its offset, the Baha, but their irrigation is a hard problem, as it is difficult to prevent all the water from escaping uselessly into the Ghaggar. Even in ordinary floods the Phara would draw off the whole of the Sarasti water were it not for a small kaolcha dam called the "Bawali," that is, "bad" thrown across its mouth. The maintenance of this embankment is of great importance for the irrigation of the estates, about ten in number, on the Lower Sarasti, but it is often broken by the force of the floods. Below Sair the Sarasti proper has a very petty channel, and on the Patiala border its bed consists of a depression a foot or two below the surface of the country, and an insignificant embankment at Andhli, known as the *Belak baad*, prevents any water from reaching the Patiala villages in ordinary years. The irrigation on the Sarasti is managed by a system of dams and cuts. Above Siwan there is usually enough water to fill the cuts and flood the lands without blocking up the main stream. But below Siwan almost every estate has its own little dam thrown across the channel to force water into the cuts. A good deal could be done by local effort to improve the present wasteful system of irrigation and to check the disease consequent on water-logging.

7. *The Markanda.*—The Sarasti below Pehowa is really the Markanda after it has dropped its silt. Higher up the Markanda is a wide sandy sho. It is a real hill torrent and rises in the Siwaliks near Nahan. In the rainy season floods come down the Markanda with extraordinary suddenness and violence, and men and cattle are sometimes caught and carried away when crossing the bed. The waters pour down numerous minor channels and spread over the face of the country far and wide, leaving, where the flow is slow, silt, and, where it is swift, sand. The floods subside very rapidly. It must not be supposed that they are uniformly beneficial. Cases are not unknown in which the people of a village have lost in a single night all their stores of grain and been left without roofs to cover them. A late autumn flood at times carries away or rots great quantities of maize which have been cut, but not garnered. The fortunes of villages, especially of those along the lower part of the river, are very fluctuating. Much sand is often deposited and the strong west winds of March blow it over the land which has escaped. But the good done by the Markanda far outweighs the losses it occasions. As already stated it joins the Sarasti at Urnat.

8. *The Umla.*—In the Shahabad Pargana of the Thanesar Tahsil the Umla is a stream of the same character as the Markanda, but much smaller. Since the first regular settlement fifty years ago it has shifted its course

a good deal eastwards, leaving Patiala and Ambala villages and depositing valuable silt in the south-west corner of the Shahabad Pargana. This process is still going on. By the time it reaches the Pehowa border it has dropped nearly the whole of its silt, but its floods cover the flat rice lands in the north of the Naili Circle. In these rice lands coarse rice is the principal and often the only crop. The waters find their way along various old channels, the most important of which is called the "Bakhli Khand." In the Naili, the name by which the tract inundated by the Sarasti, Umla, and Ghaggar is called, the foundations are most capricious and the risks of failure from drought and overflooding are very great. The former is no doubt the worst evil, for, if the rice is drowned in the autumn, spring crops of gram or wheat and gram mixed can usually be sown. The effect of the floods on the health of the people is most injurious. The men are prostrated with fever in the rains, and have to turn out to plough the stiff soil for rabi crops while it is still reeking with moisture. Many are left by fever and spleen too weak to withstand the winter cold and succumb to pneumonia. I know of no more wretched tract than the country lying between the Umla and the Sarasti in the Pehowa Pargana. The population would die out were not brides imported from the healthy uplands. The men rarely grow to middle age and are very often incapable of being fathers. I once saw a greybeard in one of the villages, and found on enquiry that he owed his abnormal vitality to a prolonged visit to the Andamans, from which he had recently returned. A few miles further west the Jats of the high-lying Andarwar Circle are as fine a peasantry as one would desire to see. The Umla finally joins the Ghaggar near Bhogal. The north of Pehowa is very flat, and the watershed between the Sarasti and the Umla is so low that it would not be surprising if the latter should some day become a tributary of the former stream.

9. *The Ghaggar.*—The Ghaggar flows west and south-west near the northern border of the Kaithal Tahsil in Rattakhara Lokman, where it is joined by the Patiala Nadi. Below this point it flows south on or near the boundary of Kaithal, which it re-enters at Urlana. A mile or two lower down it leaves the district finally, and soon after is joined by the Phara Branch of the Sarasti. At Bhogal the Ghaggar is very wide and deep, and rarely overflows its banks, but further west the channel is not quite so large, and in favourable years a considerable number of villages is flooded. The inundations are utterly precarious. The Ghaggar has two important tributaries in Kaithal, the Untarwali and Patiala Nadis. The former has two branches, one running to Kharan in Patiala, and the other to Arnauli in Kaithal and thence through the north-east corner of the Naili, till it joins the Ghaggar at Dhandawata. The Patiala Nadi takes its name from the fact that it passes close to the town of Patiala. Thence it flows south through the Powadh tract till it joins the Ghaggar. A channel known as the *Puran*, or old Ghaggar, leaves the present stream at Dhandawata, and runs south-west to Gulah, where it splits into two branches, one going west and the other south-west, and both ultimately rejoining the Ghaggar. Its bed is much silted up, and it is difficult to believe that the Ghaggar once flowed in it. But there is no doubt of the fact for we know from history that Timur's army in 1398 or 1399 crossed the Ghaggar by the curious old stone bridge at Gulah (Elliot's Indian Historians, Vol. III, page 430). All accounts show that 50 years ago the Ghaggar was much smaller and shallower, and therefore more easily controlled than it is now. A band was put up by the Sikhs every year at Tatiana, which must have done much to secure the proper flooding of the villages depending on the *Puran*, which are now in a very depressed state. Towards the close of my settlement the first five miles of the *Puran* Nadi were cleared out by the people under the guidance of an active Settlement Superintendent, but I do not know whether the improvement then effected has been maintained.

10. *Schemes for improvement of Naili.*—The tract watered by the Ghaggar, the Umla, and the Sarasti in the Kaithal Tahsil is in part water-logged and is everywhere cursed with violent fluctuations between drought and over-saturation. In many parts of it the people are of wretched physique and chronically diseased. In 1891 a scheme was drawn up to remedy these evils. It consisted of three parts—

- (1) A canal from the Markanda taking off some way above its junction with the Sarasti.

(2) A canal taking off from the great marsh to the east of Pehowa known as the Sainsa Jhil, into which the Sarasti falls and which is also fed by the waters of the Markanda.

(3) The straightening of the bed of the Sarasti to the west of the Sainsa Jhil and the removal of all bands.

11. *Projected Markanda Canal.*—The Markanda canal would have irrigated estates in the Pehowa Pargana to the south of the Umla, and in the Kaithal Pargana—

(a) a few villages to the south of the Ghaggar, and

(b) a number of estates to the north of the Sarasti.

The valleys of these two streams are separated by a high and dry tract called the Andarwar, where the dry crops are extremely precarious, but wells are numerous and the population healthy. This tract which could, I believe, be irrigated by the Markanda Canal, does not require irrigation, and this fact detracts from the value of the Markanda scheme, and militates against its being a financial success. I hope the scheme will not be finally dropped without further examination. The point to be specially considered seems to me to be whether the Markanda Canal could not be tailed into the Poran Branch of the Ghaggar, and that branch be canalized. The condition of the villages on the Poran is very bad. It is also a pity to lose an opportunity of bettering the wretched villages in the Umla Nalli.

The Sarasti Canal.—The Sarasti Canal was opened in 1896. It takes off from the Sainsa Jhil, and irrigates villages to the south of the Sarasti. In sanctioning it the Punjab Government looked on the project largely as one of sanitation. The plan of the canal is that of a high level rajbaha. The villages which have hitherto benefited from the Sarasti floods have the first claim on the waters of this canal, and I hope this will never be overlooked. Since the canal was dug two extensions have been made carrying water into the dry uplands outside the Sarasti valley. If this has been done without injuring any Nalli estate it is an excellent move. Very possibly this is the case, for I do not think a canal of the capacity of the Sarasti Canal can have any great effect in diminishing the supply of water in the Lower Sarasti in the rainy season considering what heavy floods come down the Markanda. By draining off the water of the great Sainsa Jhil the Sarasti Canal may have improved the health of villages close to Pehowa, but I do not think its influence on health can have extended very far.

13. *Straightening of Sarasti.*—The straightening of the Sarasti, and the removal of all bands, which formed the third part of the original project, might do more in this respect. But I think we should act very cautiously as regards any measure which will reduce the area naturally flooded till we are sure that we can supply the want in another way. The killah area of the 30 Nalli villages to the south of the Sarasti as recorded at my settlement was 18,600 acres, which is far in excess of the whole area watered by the Sarasti Canal in the very exceptional year 1900-01. The information on record as to how far the Sarasti Canal does supply the wants of Nalli estates appears to be scanty. A year or two ago the Deputy Commissioner noted that only 17 of the 30 Nalli villages mentioned above got water. Moreover, all estates to the north of the Sarasti must depend entirely on natural flooding till the Markanda Canal is dug, and though the land on the north bank is lower than that to the south, I should not be prepared to say off hand that it can be fully flooded in years of ordinary rainfall without bands. At present therefore I do not think the local officers should be told to forbid the erection of bands in the bed of the stream, or that expenditure should be incurred in straightening the channel. We must not take away the people's food in order to make them healthy.

14. *Irrigation from Sarasti Canal and water-rates charged.*—It was estimated in 1893 that the Sarasti Canal as originally designed would irrigate 11,000 acres. The water-rates adopted were—

	Rs.	A.	P.	
Rice	2	4	0	per acre
Other kharif crops	1	8	0	"
Rabi crops	0	12	0	"

I believe the rate on rice has been increased. The lands

also pay the land revenue assessment imposed at settlement. The irrigation has been—

	Acres.	Acres.
Kharif 1896	4,009	4,118
Rabi 1897	109	
Kharif 1897	6,164	8,904
Rabi 1898	2,740	
Kharif 1898	3,410	7,820
Rabi 1899	4,410	
Kharif 1899	2,258	2,371
Rabi 1900	115	
Kharif 1900	6,884	13,761
Rabi 1901	6,877	

The difference between the figures for the last two years illustrate the effect on the working of a canal of this sort of exceptional drought and exceptional rainfall. Canals of the kind have little value as protective famine works. Their irrigation shrinks enormously in years of drought or at the very time when that from the great perennial canals expands most rapidly.

15. *Capital expenditure, income, and annual expenditure.*—The capital outlay has been Rs. 1,16,000. Most of this money was borrowed from Government by the District Board of Karnal, and 4 per cent. interest is paid on the loan. The receipts from water-rates have been—

	Rs.
1897-98	9,554
1898-99	11,091
1899-1900	9,184
1900-01	10,292
TOTAL	40,011
Average	10,000

The charges as reported to me have been—

Year.	Repairs and maintenance.	Interest.	Total.
	Rs.	Rs.	Rs.
1897-98	917	4,019	4,960
1898-99	1,781	2,400	4,091
1899-1900	1,457	4,555	6,012
1900-01	5,813	3,695	9,448
TOTAL	9,668	14,633	24,501
Average	2,407	3,658	6,125

This seems to show that the canal pays a small percentage on its original cost. But I do not feel confidence that the figures display the total yearly expenditure. There must be some skilled direction, even if it is only that of a District Engineer, and nothing seems to be charged for that. But if it could be shown that works which really improved the condition of the Nalli paid nothing beyond their working expenses or even were maintained at some financial loss to Government, I would still advocate their construction. The existence of a tract, in the condition in which a large part of the Nalli was when I knew it, is a disgrace to Government, if the evils which exist can be in large measure removed. It is for Engineers and Sanitary Officers to say whether practical means exist of removing them. Nothing of any importance should be done by Government officers to regulate the action of these streams without the advice of skilled Engineers. Amateur engineering is quite out of place in dealing with the complicated drainage system of the country within 50 miles of the hills.

10. *Conclusion.*—I must apologize for the many imperfections of this note. I have had to write it at short notice and very hurriedly, and I have had nothing officially to do with the subject to which it relates for many years.

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1. Q. (*The President*).—You are acting Chief Secretary to the Punjab Government, I understand?—Yes.

2. Q. For how long have you held that appointment?—Eighteen months.

3. Q. What was your previous experience in the Punjab?—I was on the frontier for nearly three years in the Dera Ghazi Khan district, and for a time I held the post of Junior Secretary to the Financial Commissioner. I was Settlement Officer of Karnal and Umballa for six years, and for short periods I was Deputy Commissioner in the districts of Montgomery, Jullundur, and Gurdaspur, and I officiated as Commissioner of the Lahore Division for 18 months. I was at one time Senior Secretary to the Financial Commissioner for 18 months, and later Officiating Revenue Secretary to the Punjab Government for two years.

4. Q. What is your feeling about the management and utility of the Inundation Canals of which we have seen a great deal in the Punjab?—I think their utility is enormous, but the weak point of the system is that in seasons of drought they dry up.

5. Q. Do you think that money would be profitably spent in improving and remodelling them?—I think we should carry our large perennial canals into tracts now watered by Inundation Canals where this can be done without water-logging; the latter could not be entirely replaced. In Montgomery, for instance, I have had experience of the Ravi river valley and was especially struck by the fact that river-ain conditions exist only in a very narrow strip, the soil in the riverain tract is very like that in the Bangur tract of Karnal, clean good loam, and water is 30 feet from the surface within two or three miles of the river. The Chenab Canal is now being carried into this tract.

6. Q. Would you prefer to see the Inundation Canals treated like the bigger canals, or should they be more or less under local authorities; for instance, take the Ferozepore Canals?—I look upon the Ferozepore system as entirely a thing apart; it was started under peculiar conditions; I think it has been a success, but I have always doubted whether it would not have been wiser in Ferozepore to have gone slower and trusted to the expansion of wells in that tract which would have taken place, rather than have undertaken these canals there; they will be embarrassing in future in connection with other schemes.

7. Q. Do you believe in District Boards being able to manage such canals?—I think their management of such canals is a pure force—it is really the management of the Deputy Commissioner; they only provide the funds.

8. Q. Do you think the District Boards would rather be free of responsibility?—As a matter of fact they do nothing extensive; they could not find funds for works; they would go to Government for a loan and the interest on that loan would be covered by the profits of the canal; the District Board would have nothing to do with the management.

9. Q. You give in your report a very ghastly account of the Nali tract in Karnal. Are any other parts as bad as that?—As regards health, I know of no tract that is anything like as bad as that. As regards depression, I consider large parts of the Sharakpur tahsil of Lahore and the Ravi Valley in Montgomery and parts of the Ajnala tahsil in Amritsar are perennially depressed; they have never got their heads above water. I am hopeful of the Sharakpur tahsil now that irrigation is being extended from the Gurgera branch of the Chenab Canal into it; it is also being carried into the Montgomery tract on the right bank of the Ravi; the depression in Montgomery extends to both sides of the river. I hope with the irrigation that is now being extended we may cure a great deal of the depression of those places.

10. Q. As regards Ajnala, what is the cause of depression?—There is a stream which runs through it; its channel is simply a clayey depression in the ground; it is extremely uncertain, in addition to that in certain years the floods are disastrous.

11. Q. Was the famine felt in these parts?—In Sharakpur the population went away to a considerable extent, but the famine was most distinctly felt; there was a serious failure of crops and I found (I was then officiating Commissioner of Lahore) that there was a large area mortgaged to Sahukars and they refused to give seed to their own tenants to enable them to sow their crops. Government stepped in as regards giving seed to land-owners, but in the case of tenants-at-will we were powerless as they had no security to offer.

12. Q. (*Mr. Ibbetson*).—Which famine was this?—The last famine. Relief measures on a large scale were not required; the Anabhi Canal was re-excavated, but it never drew a large number of people.

13. Q. (*The President*).—We have heard a good deal about the rabi sowings being commenced under Inundation Canals and the work being carried on afterwards on wells?—That is the foundation of the system on ordinary Inundation Canals.

14. Q. Do you think any practical measures should be taken for extending well irrigation?—I think, as a matter of fact, there has been an enormous extension of well irrigation in the Punjab in the last 15 years; wells have increased by 20 per cent., roughly; that is not confined to one part of the province; it is general all over. I think the people sink wells freely wherever there is a likelihood of profit.

15. Q. Are the hulk of wells started by *takavi* advances?—No. Perhaps nine out of ten are started by private enterprise.

16. Q. Do you think any simplification of the procedure of taking advances would increase the number of wells?—If the object is to increase the taking of *takavi*, I think it is a matter of getting the Deputy Commissioner to take a personal interest in it and giving him time to really go into the work himself. As regards the rules themselves, I think I should be inclined to give every Revenue Assistant power to sanction *takavi* loans and simply report what he has done to the Deputy Commissioner. I should invest any experienced, Assistant Commissioner of the district with similar power; I should allow them to take the actual money into camp and should encourage them to make enquiries on the spot or send the Naib Tahsildar and Kanoongo to make enquiries, which are extremely simple. I think the main thing is the want of time on the part of Revenue officers.

17. Q. More than the necessary formalities of procedure?—I suppose formalities are required; at present the Deputy Commissioner when in camp is overpowered with other work and the Revenue Assistant and Assistant Commissioner has no power to sanction grants, so the procedure is that the application goes to the Tahsildar and he takes it up when he likes; gradually it filters back, and finally the Deputy Commissioner passes an order when he has leisure to take it up.

18. Q. The only remedy is to increase the Civil establishment of the district?—Well, in the case of the Deputy Commissioner it is absolutely necessary to give him help in Magisterial work and not require him to make up much original criminal work. I would relieve him of some of his appellate criminal work and appellate revenue work and so give him more leisure.

19. Q. Are these measures likely to come on?—I should not like to prophesy about that. I think we should improve matters by allowing the Revenue Assistant not only to investigate but sanction grants and report the matter to the Deputy Commissioner.

20. Q. Do you think the 6½ per cent. rate of interest deters a man from taking an advance?—I cannot think that has had much effect; it is a low rate of interest. But it is not a question I have gone into much.

21. Q. Do you know of any measures which would lead to a larger sinking of well?—I think the people are always ready to sink wells where it is a profitable undertaking. I think the fact that in the last 15 years there has been an increase in the number of wells from 200,000 to 250,000 is a proof of that.

22. Q. There must be a large tract where wells could be profitably sunk but are not?—I don't think there is much scope for extension.

23. Q. What is your feeling about private Inundation Canals?—My feeling is that these great perennial canals that are being dug now ought to be able to fill up the whole area of the Doabs except the very narrow strips beside the rivers, inside that narrow strip I don't see why there should be any objection to private canals; there will be an objection to private canals which are carried into a tract at a distance from the river; they would interfere with a large canal scheme.

24. Q. You were Chief Secretary throughout the last famine?—Yes, but as Chief Secretary I had no direct dealing with famine matters.

25. Q. Who prepared the famine works programme; is that done in the Public Works Department altogether?—The original idea was that they were sent up from district

and were scrutinized by the Public Works Department, and finally accepted after approval by Government.

26. Q. I was struck by a remark by Major Abbott (remark regarding Pindi-ghob read). Who settled that?—The question was carefully considered as to what tracts were liable to famine and what were not, and in the case of a district like Rawalpindi it would very naturally be decided that certain of the tahsils need not be taken into consideration; it has on enormous area, there are two hill tahsils, the conditions of which are unlike those of the western districts—the insecure tahsils in Rawalpindi are Fatchjang and Pindi-ghob—and I think the order was not to prepare programmes of any tracts in which there was no distinct danger of famine.

27. Q. I think the experience of the last famine was that it showed itself where nobody expected it?—I should be quite prepared to admit that we may have drawn the lines too close in the first list; the whole thing was carefully considered; the first list made was revised and I think these tracts in the west of the Punjab were put in at that last revision of the lists.

28. Q. The programme once made and approved by the Local Government, it rests with the Public Works Department after that?—I am not quite familiar with the process after that; the whole procedure was laid down in the revised edition of the Famine Code, and it has been revised a second time since then.

29. Q. Talking about the Lower Bari Doab Canal, Mr. Kitchen remarks that the project is regarded with vague fear; you say the remedy would be to run watercourses from this canal into the tract close to the river?—Yes, if large inundation canals had not been made here. I think the probable fear is that the head works of the Lower Bari Doab Canal at Hariko will injuriously affect the supply of the inundation canals at the beginning and end of the irrigating season. I think that is one ground of fear.

30. Q. (Mr. Abbottson).—You say that where wells can be profitably made and irrigation carried on you think that the progress already made is as much as can be desired?—I never considered the question very carefully; I think that is so, where the progress is slow one would probably find that it was due partly to the fact that wells are not extraordinarily profitable; in some parts of the Punjab well-owners are really in greater penury than the ordinary zemindar.

31. Q. Why?—Because of the expense of replacing the bullocks; a man is not prosperous because he has a well.

32. Q. Jullundur is already full provided with wells?—It has 26,000 wells in an extremely small district.

33. Q. My recollection is that in Jullundur 55 per cent. of the cultivation is well land?—Yes, very probably.

34. Q. Do you consider that well irrigation has reached its furthest limit in a tract of that sort?—Not necessarily; it would depend upon the soil of the tract; I desire you will remember that a considerable part of Jullundur, especially in the west, is sandy and barren; these sandy tracts actually extend into the Phillour tahsil.

35. Q. Why should not these sandy parts be well irrigated; why could not wells be constructed there?—It is likely if one went into the thing that you would find the sub-soil is not well suited for well-sinking.

36. Q. When it is suggested, as it has been suggested, that wells should be sunk at Government expense in parts of Hissar which are particularly exposed to famine and where the water is 100 to 120 feet below the surface, do you think that any adequate protection from famine would be attained?—None whatever.

37. Q. You think that Government would probably object to private canals being taken for away from the rivers of the Doabs, as that would conflict with future irrigation schemes; well supposing Government was not prepared to take up tracts for 20 years or so, would it be worth while to encourage private enterprise in that tract, even at the risk of paying something at the end to buy up private rights?—Yes, it might be worth while, if there was a large measure of protection possible; these canals as a rule could not be carried far into the land outside the immediate river valleys. I should not object provided it was understood that Government could buy them out at the end, and would probably do so.

38. Q. Is a royalty taken in the case of private canals?—The question was raised in the case of the Shalipur Canals, and it was decided that a royalty should be taken. The

Government of India objected to the term "royalty" in connection with the new Minor Canals Bill.

39. Q. Supposing that we can take a royalty seeing that Government derives a higher revenue from the extension of irrigation, would it be wise to make the royalty an absolutely nominal charge, if it is thought necessary to preserve the right?—I think that is practically what has been done; so far royalty has been taken to a very limited extent; the amount taken in Shalipur was four annas an acre, which is very small.

40. Q. Has a man who wishes to make a private canal any power to take that canal through the land of other people?—That would be provided for in the new Minor Canals Bill.

41. Q. Do you think that the Punjab present term of exemption from assessments on improvements created by private enterprise is sufficiently liberal?—I think in the case of wells 20 years is a good average term. Colonel Waco once worked out a calculation on the subject; he calculated that the addition made to the assessment on the land of a well on account of water advantage was Rs. 18; he calculated from that that 20 years gave you Rs. 360, and he also calculated that the average cost of a well was Rs. 300.

42. Q. It would pay to abandon the old well and take up a new one in order to obtain relief from the assessment?—That will never be done. I worked the case out as regards Karnal, and the conclusion I arrived at was that it was quite chimerical.

43. Q. Do you think that the fear of increased assessment being imposed upon land ever prevents a man from digging a well or making a private canal in the Punjab?—As regards wells, I should say it had no effect at all.

44. Q. And as regard canals?—I have never had to consider it. I should not think it had.

45. Q. With regard to the re-distribution of revenue in the case of a well falling in; in your experience is that ordinarily done?—I think in parts of the country where there is a real village-community it would be quite fair to do it; in the south-west of the province, where wells are really separate estates it would not be feasible.

46. Q. In that case is it not important that it should be done?—It is I think important that the well assessment should be taken off when a well falls out of use; otherwise a man who digs a well in an uncertain tract has the fear of being saddled with the assessment after the well has fallen in. In the tract round Thanesar when I settled it the number of wells had decreased by 25 per cent. since the previous settlement; on the strength of that I proposed for that part of the country remission of the assessments of all wells that have fallen in.

47. Q. Do you consider that Karnal is now protected from famine?—I have not actually been in the Karnal district since I settled it. I believe that the Nardak in Koithal must be very largely protected; in the Jut tract to the west I believe there has been very little canal irrigation; that never was so bad as the Nardak.

48. Q. Taking it as admitted that it is worth while for Government to spend money or relinquish money to protect a tract against famine, can you suggest anything that could be done in these tracts to render them more secure?—(Reference to map). I cannot help with any suggestions for this tract unless it be extension of canal irrigation.

49. Q. As regards the Naili drainage schemes, the sanitary question is a separate one, but apart from that, do you think these schemes will do much good as regards protection from famine?—No, I don't think so, because in a year of drought the Sirsuti Canal would be dry.

50. Q. Their chief use as a protective work would be that they would improve the cultivation of the tract and render the people more prosperous and therefore more able to withstand the famine?—Yes.

51. Q. Is it possible that such schemes as are contemplated should be carried out without depriving the lower villages of a good deal of the flood water to which they are accustomed?—I think so if it is realized that the Naili villages have the first claim on the water. They are carrying extensions into the Bangar. I have tried to uphold the position that these canals were intended to protect the Naili villages.

52. Q. You had canal tracts I think under settlement in Karnal and Umballa?—Irrigation from the Western Jumnah Canal in my time was extremely limited in the area included in my Settlement.

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53. Q. Did you form any opinion as to how far it was possible to limit the supply and force the people to supplement canal irrigation by wells, so as to make it possible to construct wells profitably?—I have not thought of that in connection with the Western Jumna Canal.

54. Q. Or elsewhere,—the Bari Doab Canal?—No, our experience has been that wells have gone out of use wherever a canal came.

55. Q. My point is if they had to pay the wet assessment they would not be able to pay the canal rates also and whether they could supply the place of canal water by well water?—They would not be so ready to throw up canal water. I made a proposal as Settlement Officer on these lines when irrigation from the Sirhind Canal was being introduced into the Powadh tract in Knithal.

56. Q. As Chief Secretary to Government, have you any knowledge of any difficulty in obtaining money for minor irrigation works?—No, it has not come directly before me.

57. Q. Have you known cases in which works of importance on the preparation of schemes for the improvement of irrigation were hung up for want of funds?—My feeling is this as regards the working of the Irrigation Department, that in the past it has sometimes been worked too exclusively on a financial basis; a scheme has been taken up purely if it would pay and schemes which would pay less have been put aside. I should like to see the Irrigation Department put in the same position as the Forest Department has been put, that is a Department which has to look after the general well-being of the country; I don't mean to say it is not that to a great extent, but there has been a tendency of the kind I have pointed out.

58. Q. Do you think any material stimulus would be given to irrigation if the Local Government had a larger pecuniary interest in the income derived from it than they have now?—Yes, if it was a real pecuniary interest, not a provincial contract interest.

59. Q. Do you think you could help the people of the Punjab by sinking wells, by the offer of expert advice on the use of harrow tools, or means of that sort?—I don't think it could be done.

60. Q. It has been suggested that Government should sink wells in private lands with the consent of the owners and recover the cost by a charge upon the irrigated area; do you think that that scheme would be acceptable to people and would work well?—At the first blush it would be looked upon with considerable suspicion.

61. Q. (Mr. Rajaratna).—Have you any information about the amounts advanced on account of loans for wells for the past 10 or 15 years?—In the past 8 years 21 lakhs have been advanced.

Mr. Wilson explained that more than half of that 21 lakhs had been advanced to colonists on the Chenab Canal.

62. Q. (Mr. Rajaratna).—Is there any disinclination on the part of the people to take loans from Government? I think the great majority of the loans for wells are taken from Sahukars; I should not say there was a disinclination; they are held back by certain difficulties in our procedure—it has been suggested, that one reason that may prevent loans being taken from Government is that the people cannot afford to quarrel with their Sahukars.

63. Q. Is there any reason to suppose that the full benefit of the loan does not reach them?—Every reason—a man has to grease the palms of certain people.

64. Q. Would it be 25 per cent.?—No, nothing like that, I should say 2 or 3 per cent.

65. Q. Would you invest Tahsildars with power to sanction grants to avoid delay?—I think not; I should invest Revenue Assistants and any experienced Assistant Commissioner, and possibly experienced Extra Assistant Commissioners.

66. Q. Would you fix any limit on the grant or give them full power?—Yes, I think I should fix a limit of say Rs. 400 or Rs. 500 and should make them report to the Collector what had been done.

67. Q. At Sukkur we were told that the Treasury officer did not allow Tahsildars or Collectors to sanction payment except upon an order from the Commissioner; would there be any such difficulty here?—No.

68. Q. Would you advocate the employment of special officers to grant loans in connection with facilities for the construction of wells?—No, I think the proper thing is to give the ordinary officers more leisure.

69. Q. How?—By relieving the Civil officer of original criminal work, and a considerable amount of appellate criminal and revenue work.

70. Q. You would increase the staff?—Not necessarily.

71. Q. Would the extension of wells be stimulated by extending the period of exemption from 20 to 50 years?—I don't think that it probably would. I should be strongly opposed to carrying out a policy of that sort. I think our present provision which gives 20 years as the advisory rule and allows the Financial Commissioner to extend the period is a good rule. I should place the power given to the Financial Commissioner in the hands of the Commissioner and instruct him to use it freely in the case of expensive wells.

72. Q. Is this extension granted in many cases?—My impression is that it is not; Collectors probably very rarely propose it.

73. Q. Is there any limit to the period of extension?—No, it is left to the discretion of the Financial Commissioner, to whom a reference is required in every case.

74. Q. You said that well-owners are not prosperous?—No, I said that in certain small tracts in the Punjab where they are not prosperous, it is due to smallness of holdings and the necessity of keeping up bullocks.

75. Q. How many crops do they rise in the Punjab?—The systems of cultivation on wells in the Punjab are extremely diverse; there is every extreme and the area irrigated on a well ranges from 35 acres to 4 acres.

76. Q. Are the wells referred to in your memorandum independent of canal irrigation?—In a district like Jullundur, which is more or less submontane, wells are not supplemented by canals, but in a great part of the south-west of the Punjab, wells near the canals are used to ripen the *rabi* crops, which have been sown on a flushing from Inundation Canals, if possible.

77. Q. On wells which are not connected with canals at all there is an increase in the assessment after the exemption period?—The rates on well lands in the Punjab would be found to vary from 12 annas an acre to Rs. 5 or Rs. 6 an acre; the safest thing you could say is that you would add about Rs. 1 or Rs. 1-8 per acre more on account of well irrigation; the general rates in the Punjab are low and they vary immensely owing to the enormous differences of climate in different parts of the province.

78. Q. On wells connected with canal systems what is the increase? Is there any increase at all or do they pay the canal rate?—They pay a *chahi nahri* rate.

Mr. Wilson explained that as regards the Multan district, the average rate per well over and above the canal assessment is Rs. 20 for the whole district.

79. Q. (Mr. Wilson).—You spoke of the depressed parts of the Ravi Valley, is that in any way due to the opening of the canals higher up?—No, the Ravi Valley has been depressed any time since annexation; recently that has increased owing to the drawing away of tenants to the Chenab Canal.

80. Q. Does any responsibility lie upon Government to take into account the injury that may be done to the riverina valleys when one of these perennial canals is opened?—I think the first thing Government should do is to remedy the evil as much as possible by carrying irrigation to the villages in the river valley but at a distance from the river.

81. Q. Would it not be reasonable to ask Government, when a project for constructing a large perennial canal is being considered, to take into consideration the effect it will have on the riverina valleys below the river and provide for a branch canal for maintaining the prosperity of these villages?—Yes, if there is any way of feeding these Inundation canals from the perennial canal.

82. Q. Or by deepening the beds of the existing Inundation canals?—Yes, certainly, if it could be proved that the Inundation canals would be injured by the excavation of the perennial canal, it would be proper to include in the project, estimates for making the additions to the Inundation canals, and charge that to the capital account of the main project.

83. Q. Is it not reasonable to ask Government in consideration of the increase of land revenue which it will receive to help District Boards in maintaining and constructing such canals as are maintained by District Boards?—Yes I think it would be reasonable, but I don't think there is

much scope for such action; in the end the natural history of the canal is that it will be taken over by Government.

84. Q. You spoke of the difficulties of District Boards in obtaining funds; they have to borrow very often?—In a case like the Sarusti Canal they had to borrow the whole.

85. Q. In times of drought the funds of the District Board fall very considerably?—Yes.

86. Q. And in such times it is difficult to keep up canal in proper order?—It must be.

87. Q. It is desirable to give water to tanks for drinking purposes in some dry parts of the country?—Yes, most certainly; it would have saved an immense deal of trouble in the famias which I saw in the Karnal district.

88. Q. In that case would you charge anything for water given for drinking purposes to villages?—Something quite nominal.

89. Q. It would be no profit to Government?—It would keep the cattle alive.

90. Q. Would you also be in favour of spending some money to get water into the tanks?—Yes.

91. Q. (Mr. Higham).—Are not tanks filled by canals?—Yes, but I don't think it has been done much here.

92. Q. Tanks are filled from canals free of charge?—I cannot say.

93. Q. (Mr. Wilson).—In the case of tanks within reach of the existing water-courses, in some parts of that dry country would it not be desirable for Government to spend a little money in extending the water-courses for the purposes of filling the tanks?—You would not carry a water-course very far on that account; it would only be a partial protection from famine.

94. Q. Where it was possible to do it without large expenditure would you be in favour of doing it?—I think the scope would be extremely limited.

95. Q. Where it could be done it would be a great convenience and people would have water in the tanks?—Yes.

96. Q. You give a description of Karnal 12 years ago; you know something about its history; has there been a great improvement since?—Yes.

97. Q. And also a reduction in excessive water-logging from the Western Jumna Canal?—Yes, the part that I know did not suffer much that way.

98. Q. Has the health of the people improved?—I cannot say—I know no reason why it should have improved.

99. Q. You speak of the difficulty of making arrangements to extend irrigation in villages where it does not exist, and you say nothing should be done without the advice of a skilled engineer; to what extent have we got a survey of the country?—There was a survey made by Rai Bahadur Ganga Ram of these hill streams and since then the Irrigation Department have surveyed a good deal.

100. Q. If any part of the country has not been surveyed you think it should be done?—Yes.

101. Q. There is not much chance of the Provincial Government advancing the money for such a survey?—No, not in the present state of the finances of the Government.

102. Q. Do you think the Government of India should be asked to complete the survey and have these schemes drawn up at its cost?—I think that should be accepted as a part of the work of the Irrigation Department, and paid for by the Government of India as a part of the general expenditure of the country.

103. Q. Do you think this should be done even if there should be no direct chance of financial gain?—Certainly.

104. Q. What is the average rainfall of that tract?—When you come down towards the Sarusti Canal it is 18 inches.

105. Q. Is it not the case that the rainfall varies from year to year?—Yes.

106. Q. In some years far too much water?—Never far too much water for the peoples' desires probably; after the water has subsided they get magnificent *rubis* crops.

107. Q. Do you propose to take means of sending the water further down?—I should like to see the *kds* lands all commanded by the Sarusti Canal and confine the irrigation from the main channels to the lower lands.

108. Q. If canals were made from these streams, would they not be liable to fail in times of drought?—If the

drought was so severe as to prevent water going down the Alkanda, the usefulness of the Sarusti Canal would be very much diminished.

109. Q. In how many years is such a drought likely to happen as to make the canals fail?—Once in five years.

110. Q. If we extend irrigation to that tract is there danger of the population being increased and suffering more severely in times of drought?—I don't think that would be the practical result; I think if the population were more healthy and vigorous and more prosperous, they would move off somewhere. I should not like to see the Naili population increased under the present conditions.

111. Q. You spoke about the difficulty of keeping wells going in times of drought; is it not the case that, even in a time of drought, a tract which has wells is able to grow at all events fodder for the bullocks which it could not have done if wells did not exist?—Up to a certain point; if the drought is prolonged there would be great mortality among the bullocks.

112. Q. Would not such drought as to make the bullocks die be a rare occurrence?—I think a large number of bullocks would probably die in certain tracts if the drought was prolonged.

113. Q. Would there not be more bullocks on account of the wells being there?—There might be more animals left, but they would be in a very bad condition.

114. Q. After 20 years' exemption, Government gets an increase of land revenue, and this it gets without any direct expenditure of its own?—Yes.

115. Q. Is it not reasonable that Government should incur some expenditure in consideration of this increase, in order to aid in the construction of wells?—I think there is nothing unreasonable in it; I don't think it is necessary or even desirable.

116. Q. Is there not some waste of money in trying to sink wells which are afterwards found to be not suitable or not usable?—Yes, I suppose there must be occasionally.

117. Q. If you have an expert with boring tools who went round to help the people to find out what the layers of ground were like, would it be of some assistance to them in deciding where and how to build a well?—I don't think, to start with, they would themselves attach any importance to this, but I think it would be useful; anything which enabled you to gain a knowledge of the sub-soil, etc., would be useful.

118. Q. Would it not be an advantage to Government to employ such a staff and the tools free of charge in order to get more wells made in proper places?—I should doubt whether the practical effect would be a great stimulus, but I don't see why Government should not offer that help to the people.

119. Q. You said that it was desirable in order to encourage the people to take *takavi*, an officer should have the money with him and go round giving it himself; could this not be done more rapidly than it is now if an experienced officer were placed on special duty to distribute the money?—I have a great distrust of the introduction of special officers; I think a man who knows the district is better for the purpose.

120. Q. At present he has not the time?—The remedy seems to be to give him the time; the more special officers you introduce the more you diminish the power and status of the Deputy Commissioner.

121. Q. He might work under the orders of the Deputy Commissioner?—Yes, still he is the special officer and people will look to him and not to the Deputy Commissioner.

122. Q. It would be done more rapidly?—Yes, the officer would have nothing else to do.

123. Q. (Mr. Wilson).—(After reading rule in regard to repayment of *takavi* loans).—Would it not be desirable to give the Commissioner the power to extend this period of repayment?—If 20 years is given it fits in with the term for which the man has not to pay wet assessment.

124. Q. In special cases it is advisable to extend the period of exemption from assessment?—In any case where it was necessary to extend the period of exemption that would be usually owing to the costliness of the work and in that case I should be quite prepared to give the power to the Commissioner to extend the period. I found in the Jhang district that they charged penal interest when a man was a few days late; the order I gave at the time

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Nov. 01. was that a month's grace should be given—a man was to be treated liberally.

125. Q. Considering that Government realizes 6½ per cent. on these advances and that it in the end gains greatly by the construction of a new well, don't you think you might fairly give a charging canal interest?—No, I think you should suspend instalments in a regular way more freely.

126. Q. (*Mr. Ibbotson.*)—In the Punjab you keep accounts of capital and interest separate?—Yes.

127. Q. That renders the accounts very complicated surely to the Revenue Officers?—No, they read it straight off. It is all done on tables: it is a simple matter of copying.

128. Q. (*Mr. Higham.*)—Regarding the Sarnati Canal, you say the original scheme consisted of three parts, of which one part has been carried out; I understand money was lent to the District Board by Government?—Yes.

129. Q. They were responsible?—Yes, they pay interest to Government on the capital.

130. Q. Did Government give any assistance at all?—No, in the first instance I think surveys were made and the work was commenced by the District Engineer, Mr. Atkinso.

131. Q. Why was it left to the District Board to find the money; on what principle were they required to take it up?—I think probably the root of the matter is what I consider a mistake in the conception of the functions of the Irrigation Department, namely, that that Department should take up schemes of financial promise, but not be directly concerned with these small works of sanitation, etc., which are of doubtful value regarded from a purely financial point of view.

132. Q. I understand you to say that the District Board as such has no means of forming a judgment?—Absolutely none.

133. Q. As the District Board has got the water-rates, it pays it to develop irrigation in the high tract which is now served by the canal?—Whether it has actually financially paid it or not I do not know; there would be a cry for water from that high tract; it is quite possible that the cry has been listened to.

134. Q. You are afraid that these *Naili* villages may be neglected?—Yes, these *Bangar* villages should be left alone; the first call should certainly be for the *Naili* villages.

135. Q. It is quite possible that the District Boards might find it financially more profitable to take irrigation into the *Bangar* and neglect the *Naili* villages?—I think that it is not a financial scheme but a scheme for trying to restore these villages to a decent state of health and prosperity.

136. Q. Is that not a reason why matters should be taken up by the Provincial Government rather than the District Board?—Yes.

137. Q. This part of the scheme is the simplest part?—Yes, the Markanda Canal, which is the other part of the scheme, is not a canal you would ever look at except as a means of suring certain evils.

138. Q. No District Board is ever likely to take up this part of the scheme (referring to the second part) if they are not going to get anything out of it?—It should not be encouraged to take it up unless it is financially safe; the whole of the Karnal district should not be called upon to pay for the benefits of a small part.

139. Q. And as regards the third part of the scheme, the straightening and opening out of the *nala*, there is no financial benefit there either?—No; it would pass water off quicker.

140. Q. Is there any possibility of this scheme being carried out as long as it is left to the enterprise of the District Board?—The District Board do what they are invited to do by the Deputy Commissioner; I don't think they should be encouraged to take up the scheme.

141. Q. This scheme is likely to be a good thing from a sanitary point of view, but it won't increase the area of cultivation, will it?—No.

142. Q. Nothing has yet been done; the difficulty has been money?—Yes.

143. Q. (*The President.*)—I gather that irrigation in the upper portions of the Western Jumna Canal is so fixed now that it could not be taken away in very large quantities to pour water down into Hissar?—It has been changed very much in the last 20 years; irrigation used to be in the *Khadi* villages; it has been taken away to the higher lands.

144. Q. (*Mr. Ibbotson.*)—You say that you would not encourage the district Board to take up such schemes because it would not be fair to the people of the Karnal District to pay for this tract. I suppose you mean that you would not devote any undue proportion of the funds to the relief of one tract?—Yes.

WITNESS No. 21. LALA NANAK CHAND, Conol Tahsildar, Peshwar.

Lala Nanak Chand.
8 Nov. 01. 1. Q. (*The President.*)—You are Conal Tahsildar, of Peshawar, I understand?—Yes.

2. Q. How long have you held that post?—For the last nine months.

3. Q. What were you before?—Tahsildar at Mardan.

4. Q. What are exactly your functions as Canal Tahsildar?—My functions are to see all the works done by private canals and decide revenue and criminal cases and distribute water, and assess water-rates on Kabul River Canal.

5. Q. How are these canals managed; by the District Board or the Deputy Commissioner?—By the Deputy Commissioner. There is one District Board Canal which is also under the Deputy Commissioner.

6. Q. Is the management satisfactory?—Yes.

7. Q. How are repairs carried on there?—On the private canals by *begar* entirely; on the provincial canals they are paid by provincial funds.

8. Q. You get a budget allowance every year?—Yes.

9. Q. What is the extent of cultivation?—On private canals 1,31,000 acres.

10. Q. Where does this water come from?—Some fifteen canals which are supplied from the Kabul River and 18 from the Swat River.

11. Q. You have nothing to do with the Swat Canal?—No, only with the Kabul Canal.

12. Q. What is the cultivation from it?—30,000 acres.

13. Q. There must be a considerable amount of money spent in maintenance and repairs?—That is done by the maintenance Department.

14. Q. Are there any masonry works?—On one canal here is a weir: Rs. 6,000 was spent from district funds.

15. Q. To whom do the private canals belong?—To the majority of the zamindars.

16. Q. Do they have a *panch* for managing them?—No; they are managed under regulation No. 4 of 1898.

17. Q. Is there land there, which is required to be irrigated which cannot get water?—There are 80,000 acres which it is proposed will be irrigated by the Kabul River Canal; there is another large area which can be irrigated by the Pihur Canal from the Attock River.

18. Q. How do the people pay for this?—They pay wet assessment.

19. Q. There is no canal rate?—No, not for the private canals; Rs. 5,75,000 wet assessment is paid for these canals.

20. Q. Have you any point you would like to place before us for the improvement of these works?—The only thing is if *pakka* heads are made for the canals it will be a good thing.

21. Q. There are none just now?—No.

22. Q. District Board funds could not do it?—No, it would require provincial funds.

23. Q. How much money do you think will be wanted for that?—I cannot say.

24. Q. Is there an Engineer employed to survey these canals or inspect them from time to time?—There is a sub-overseer who inspects the private canals; over the Kabul River Canal there is a Sub-Engineer.

25. Q. (*Mr. Rajaratna.*)—You said 131,000 acres were irrigated by private canals?—Yes.

26. Q. These canals were constructed by the zamindars themselves?—Yes.

27. Q. Will there be a wet assessment upon that?—Yes.

28. Q. Do the rates vary?—Yes, they vary.

29. Q. Is the wet assessment lighter than the rates charged upon Government canals?—Yes.

30. Q. Why could not owners of private canals carry out the head-works that you refer to?—They are not sufficiently well off.

31. Q. Would they take loans from Government and carry out the works?—Yes, *takavi* is given to them.

32. Q. What is the rate charged on Government canals? *Lala Nanak Chand.*
—Rs. 7 per acre for sugarcane.

33. Q. These rates are much higher than those paid by the *zamindars*?—Not much. 8 Nov. 01.

34. Q. Is there any scope for extending these private canals?—30,000 acres more can be irrigated by the *Hazargain Branch* in several villages.

35. Q. Will that be done by Government?—Yes.

WITNESS No. 22.—MALIK NAWAB KHAN, Land-owner, Peshawar.

—In reply to Mr. Ibbetson the witness said:—I am a *zamindar* and canal owner in the Peshawar district. The canal is a private canal, some 250 years old. We pay nothing for the water, but we keep up the canal and do the clearances ourselves; Government manages it for us. There is plenty of water, but the Government officers have not time to look after the distribution properly. We have a

complicated system of shares, but there are disputes and there is not enough supervision over the distribution of the water. Masonry heads are badly wanted and would not cost much. The surplus water is sold by auction and realizes Rs. 5-0 yearly. We could pay for improvements or would take *takavi*. About 400 shareholders own the canal which irrigates 34 villages.

Malik Nawab Khan.

WITNESS No. 23.—MR C. J. HALLIFAX, I.C.S., Judicial Secretary to Government, Punjab.

Memorandum by witness on the Gurgaon Bunds.

1. My experience allows me to touch only on points numbered 4 and 7 in the memorandum attached to the letter No. 2 from the Secretary of the Commission to the Punjab Government.

2. For about two years, in 1894-95, I was in charge of Gurgaon, where district irrigation works have been constructed, and I can speak of the history of these works up to the time of my leaving the district. The following remarks are taken, with some slight alterations, from a memorandum which I wrote on the position of the Bunds as it stood in the beginning of 1896; I am unable to say what developments have taken place since I left Gurgaon.

3. The district irrigation works consist of a number of Bunds or dams, built, usually of earth, at places where the floods of the rainy season can be conveniently intercepted so as to prevent their flowing into the lowest depressions of the district in which they would lodge if unchecked. The object in view is to prevent the waterlogging of the lowest depressions and at the same time to use the intercepted water for irrigation. Flood irrigation is given by means of the dammed up water to the area above, or up-stream of, the Bunds, and the area below, or down-stream, is irrigated by flood irrigation when the dammed up waters are liberated by opening sluices or cutting the Bunds, or, more recently, by water led off in *najbahs* or channels from the Bunds.

4. When the existing Bunds were constructed, the main object in view was, I believe, the protection from waterlogging of the depressed areas of the district, and from this point of view all the Bunds of the district are very closely interconnected. The isolated Bunds in the district that are unconnected with some regular system are few. A large number cannot be looked at individually or apart from the system to which they belong, each being regarded as a link in a chain which has been gradually evolved and lengthened, and on the two important systems, viz., the Kotla and Najafgarh protection works, there are series of Bunds, each of which has so direct and distinct an effect on the safety and usefulness of the whole system that the abandonment of anyone, simply on the results of the figures showing profit or loss on it alone, and without regarding the effect it has on the system, would be difficult. Some of the Bunds, it is true, particularly on the Najafgarh Jhil watershed, and the Bunds intended to control the Sahibi and Indori, are not so closely connected with each other. But it will be convenient to deal with every Bund in connection with those which it assists in any way, and for this purpose I propose to divide them into groups as follows:—

I.—Works for the protection of the Kotla Jhil.

II.—Works for the protection of the Najafgarh Jhil.

III.—Works for the utilisation of the Sahibi and Indori torrents.

5. In connection with the Kotla Jhil system, a few remarks are necessary as to the characteristics of the country which is affected by it.

Four very considerable depressions in the level of district are known as the Khalilpur, Chaudeni, Sangel-Ujina, and Kotla Jhils.

The Khalilpur Jhil is situated in the north-east of Nuh Tahsil: it is the deepest part of a low piece of country about 10 square miles in extent around Khalilpur, Indri, and other villages, regarding which Mr. Macdonachie, Deputy Commissioner, who took the greatest interest in the Bunds, has noted that "during ordinary rainy seasons the whole of this is flooded. A part of it just north of Khalilpur village * * * has a more marked depression: water stands 4 or 5 feet deep here after the rains, and the land is a more or less permanent swamp * * * Its area may be reckoned at about 15,000 acres."

The Chaudeni Jhil lies about 10 miles to the west of the Khalilpur Jhil and is situated in the north-west of Nuh Tahsil; regarding it Mr. Macdonachie writes: "Here is another permanent swamp, with standing water which very rarely dries up altogether. The area which comes under flooding here is about as large as the Indri Jhil: the permanent basin is perhaps somewhat smaller, say about 1,000 acres."

The Sangel-Ujina Jhil is in the south of Nuh: it is not so clearly defined a basin as the other Jhils, but from this very fact, when water stands in it, it spreads over a larger area than is covered at Khalilpur or Chaudeni, and the lands of numerous villages near Sangel and Ujina are widely flooded, so that the damage caused to them is extremely serious.

The fourth and most important Jhil, that of Kotla which is the largest in the district, being 3 miles long and 2½ broad, lies in both Nuh and Ferozepore, where these tahsils adjoin each other at the foot of the Alwar Hills.

6. These Jhils are filled by the drainage coming down towards them from all four points of the compass.

The north drainage comes from the direction of Sohna and is that of the eastern slopes of the Thoro plateau and the spurs adjoining it. From the north-west the Mehndwara, a considerable torrent, and some smaller streams come down, bringing the drainage of 100 square miles between Bhundvi and the hills towards Rojka on the Delhi Gurgaon border. The line of watershed separating the flow towards Kotla and that towards Najafgarh is found at about seven miles from Gurgaon—the reduced level of what may be taken to be the highest point being about 756 feet above the sea at Khalaka—and the rainfall of all the country to the south of this line is therefore thrown towards the Kotla Jhil. The water of the Sohna, Mehndwara and other streams is joined in the flat country to the north-east and east of the Indri Hills by the Sailani drainage, which brings down waters from a catchment area of about 100 square miles in the Delhi District towards Ballabhgarh, and fills two small Jhils at Khuntari and Sarinathla on its way to Sailani. A small part of these north and north-west floods reached the Chaudeni Jhil direct, but they chiefly went to fill up the Indri-Khalilpur basin, whence they spilled over into Chaudeni. The general level of both the Khalilpur and Chaudeni basins is about 925 feet above the sea, though parts of the Chaudeni basin are lower. After filling these basins the floods naturally overflow the higher ground by which they are surrounded and find an exit from Chaudeni towards the south. Originally Chaudeni discharged itself directly into the Kotla

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Jhil and swelled the volume of water that collected there, thus increasing the difficulty of dealing with it. But the Chanderi Cut was devised to prevent this, and if any overflow occurred it was taken by the Cut into the Sangel-Ujina Basin, which was generally lower than the Chanderi Basin itself, being on an average elevation of about 620 feet above sea level. In wet years there was, before the works were completed, still a bit of water that found its way from Sangel and Ujina into Kotla, but this has now been provided for, as will be noted below.

But the most important drainage towards the Kotla Jhil is that coming from the south along the Farozpore Valley. The Landohi, which has a catchment area on both sides of the Alwar Hills (from which the Jhil Stream also joins it near Farozpore) as well as on the hills from Bajhera to Ghata Shamsabad, collects an enormous volume of water during its course of over 22 miles. The drainage of the hills to the west—particularly the Balanj Stream—and of the Bangar to the east also flowed into the Kotla Basin, the character of which at an elevation of about 603 feet only above sea level, surrounded as it is by high land on all sides, prevented any outlet till the Jhil was full. When this happened the whole country for many miles around was under a continuous sheet of water which finally escaped by flowing south-east between Bajhera and Kalingar round the range of hills ending at Udhara, and continuing its course by Sakrawa, Panahana, and Lehinga, filling up and overflowing from numerous depressions on the way, till it ultimately reached the Bharatpur border of the district.

The damage caused by the Jhils was thus incalculable. The Kotla Jhil before it was protected could never have been dry; the other Jhils in wet years would always contain a large area in the lowest parts of their basins which was uncultivable on account of floods; they kept good lands out of cultivation, and permanently flooded the low lands best suited for cultivation; they detrimentally affected the health of the tracts in which they were situated, which, and that of Nuh in particular, were at one time hot beds of fever; and they always, in times of flood, seriously endangered the position of the town of Nuh and of all villages near them or the line of their overflow. The extent of the damage done to the crops and of the loss of revenue may be estimated from the fact that it was necessary at the last settlement to frame special rules for restoration of revenue, which in 97 so-called "submerged" villages is claimable by the raiwaddars when 10 per cent. or more of their lands are uncultivable on account of inundation, while in 7 villages the revenue had to be left entirely fluctuating.

7. The first that required most protection was obviously the Kotla Jhil, and thus about 1835 the first steps to regulate the drainage of the district were taken with a view to protect it. A Bund and catch-water drain were then constructed, which started from a point in the Alwar Hills at a little to the north of the place where the Balanj Stream comes down and continued by Ghata to the west of Sangel; a canal, known as the Chanderi Cut, was also dug at the same time to bring down the waters of the Chanderi Jhil. These works threw the floods of the Landohi and Balanj, and the spill of the Chanderi Jhil, into the Sangel-Ujina Basin, with the intention that they should pass off by the Bajhera outlet and by the course already noted towards Bharatpur, without reaching Kotla, and an old badhabhi dam at Alwar, which blocked the cut-flow, was cut to allow free passage to the floods. But the embankment and drains did not effectively serve their purpose till the summer, which originally ended some three or four miles short of the canal, was continued so as to join the Chanderi Cut; at the same time the Chanderi Cut was improved, and the passage through the Minwai drain was widened in 1852-53. Till this was done the object of the works was defeated in wet years, because the waters, which the embankment and the canal carried into the Sangel-Ujina Basin, flowed round the north end of the embankment between it and the canal, and still found their way into the Jhil. The length of the embankment is now 12 miles, while that of the canal is 9 miles. They effectively prevent the entrance into the Jhil of any water from outside, and since 1845 have been properly kept up, and considering the consequences of any breach and the length of time which is required before floods that reach the Kotla Jhil can dry up, it is imperative that they should be maintained in good order.

8. After the construction of the Kotla Embankment and Chanderi Cut, works connected with them were undertaken which divide themselves into three classes, viz.:—(a) Works intended to assist the Jhil works by lessening the

floods reaching the embankment and relieving the over-flooding of the villages into which the embankment throws back the floods diverted from the Jhil, and at the same time to provide irrigation or prevent flooding at the places where they are constructed; (b) Works constructed to control the water collecting inside the area protected by the Kotla-Chanderi works; and (c) Works whose object is to regulate the overflow from the Kotla-Chanderi works and to utilise it for irrigation, after it passes the outlet at Dnjheim.

9. Of the first kind no scheme was taken in hand till 1860-61, when the Raising-Munhumadpur Bund was constructed as a famine work. There was possibly no direct intention in constructing this work of lessening the drainage flowing towards the Kotla Basin, but as the Bund has that effect it is classed as one of the Kotla system. The Sohna Bund was the next to be made in 1886. It blocks up a narrow opening near Sohna which is the outlet for the rain collected in the hills which rise up to the Toru plateau around Sohna and extend from that town towards Bhundsi, and it is of considerable use in holding up a large body of water that but for it would find its way directly into the Jhils. An old Bund had existed on the site of the present Sohna Bund before the British occupation of the country. The last work of the first class is the series of Bunds and drains known as the Qasari Scheme, which was carried out in 1885 and includes Bunds at Khalipur, Qatabgarh, Chanderi, and Domichi, as well as smaller embankments from Qatabgarh to Himmathala, and Himmathala to Ghatera, and an improvement and elongation of the Chanderi Cut, together with the cutting of the Qasari drain towards Duraichi. The main work is the Qatabgarh Bund, which is designed to hold up and utilise for beneficial irrigation the drainage that has been described above as filling the Khalipur and Chanderi Jhils, lessened as far as it is by the action of the Sohna and Munhumadpur-Baisica Bunds. The Khalipur Bund protects the Jhil of that name and throws the water that flows towards it into them in Qatabgarh Bund, from which embankments run towards Ghatera and Himmathala at such levels as to conduct irrigation to lands that would not be reached without them, while preventing any overflow towards the Chanderi Bund. The Qatabgarh accumulations are carried off by the Qasari drain, and are then guided by the Duraichi Bund, which is so situated that any waters that pass it cannot go into the Sangel-Ujina Basin, but flow along a depression separated from that Basin by land of higher level, and discharge themselves into the Malai Water-Course below the Bajhera outlet. The Chanderi Bund intercepts from the Chanderi Jhil what remaining water beyond that already intercepted by the Qatabgarh Bund would flow into that Jhil, and this water is taken off by the new Chanderi Cut into the old Chanderi Cut and set towards the Sangel-Ujina Jhil.

10. The regulation of the drainage inside the Bund was first taken in hand in 1853, when the Palri Bund was constructed. This was followed by one at Alania in 1859 and Bunds at Falia and Mau in 1870. Each of these Bunds deals with independent drainages and they have no connection with each other, except in so far as they all have the common object of preventing water collecting within the lice of the Kotla dam and Chanderi Cut from reaching the lowest level of the Jhil where all control over it is lost, and they are intended to deal with the rainfall inside the larger works at points where higher levels allow of its regulation.

11. The utilisation of the water overflowing from the Sangel-Ujina Jhil had up to 1860 been attempted by three works only. These are the Sakana Bund built in 1857, the Shah Chokha Bund built in 1858, and the Malai Water-Course made in 1891. The first two are bullock works as well as Bunds; they are constructed on the lines of canal district roads, which are now raised above their former levels and thus rendered impassable at all seasons, instead of being impassable during the rains. Bridges have been put in at the points in each road where the water, after it has been dammed up by the embankment and thus a real purpose for food irrigation, seeks its natural outlet and these bridges are fitted with slides which are used to regulate the flow. A rajhat is attached to the Shah Chokha Bund, and is beneficial in allowing a part of the dammed up water to be led off for high level irrigation. The Malai Water-Course carries off flood water from low lands near Kalliojr towards Utawar, throwing it on to villages such as Malai, Shalapur, Utawar, and Maloka, which require it. All these works, therefore, are intended to regulate the Sangel-Ujina overflow so as to relieve villages waterlogged by it and to utilise the water so as to prevent more than can be

helped from reaching as far as Lohinga and the villages around it, where a series of considerable Jhils and stagnant pools are formed in the numerous depressions of the tract. The works may, of course, be regarded as independent of each other to a considerable extent, except that each work nearer the Jhil relieves those further down the line taken by the overflow and thus renders them more practicable and more easily worked.

12. In this connection should be mentioned the Bunds at Rawa and Ghata Shamsabad. A series of works formerly existed in the valley between the Alwar and Biwan hills, from near Ferozepore and the Bhartpur border, for the purpose of checking the Landoha in its course towards the Jhils. These were the Pansari, Kanmeda, Landohn-Nagli, and Bhind Bunds and the Batai water-channel. The District Board now, however, has no concern with them, and they have been abandoned or made over to the zamindars. But the Gurgaon District Board still keeps up the Ghata Shamsabad and Rawa Bunds, both built in 1890. These do not, it is true, deal directly with the Landoha floods, but do so indirectly by intercepting drainages from the Biwan Hills, which flow into the Landoha. Both are primarily protection works. The former is meant to prevent the deposit of sand in the villages of Alipur, Kanmeda, Tigra, Hirwari, and Madapur, which were formerly affected by the Nuloh now banded up, and it gives flood irrigation to Ghata Shamsabad as well as securing the deposit of silt in broken land up-stream and thus increasing the cultivable area. The latter deals with the water of the Daror Naloh, which flows down the west of the hills to the east of Ferozepore; Rawa, Raniola, Ranioli, Dughri, Namzapur, and the south-east corner of Sakas are protected from sand by it, but the bund does not afford any irrigation, except indirectly by the effect of percolation.

13. The only other bund in this part of the district is an isolated one at Dongocha, which it will be well to notice here. It has nothing to do with the Landoha or the spill from the Jhils, but intercepts an independent drainage coming down a branch of the Daror Nuloh from the hills to the west of Dungacha and on the east face of the hills, opposite the Rawa Bund. The water is used for flood irrigation, and as it would, if unarrested, join the Jhil overflow in flooding the Lohinga country, the bund is useful for the solution of the problem of the protection of that tract.

14. The above disposes of the works at present existing which are in any way concerned with the protection of the Kotla Jhil and the schemes connected with it, and having now described the position and inter-connection of the works which regulate the floods coming down from all points of the country towards the Kotla Basin and the floods that are thrown back from it by its protective works, it will be convenient, before considering the other bunds of the district, to look into the financial position of this system.

In doing this it is necessary at the outset to scrutinize the very heavy figures at which the original outlay on the older works has been reckoned. The expenditure on all the more recent works has been correctly ascertained, and it is therefore possible to make a proper estimate of the profit and loss on them. But in the figures recorded in the district office for the old Kotla-Chandani Works and perhaps for the Raisina Muhammadpur Bund, there seems to have been over-estimation of the capital sunk in them. In the case of the Raisina-Muhammadpur Bund this is not serious, and as there are two very large and elaborate weirs on it, and the figures of expenditure were obtained from the Public Works Department, it is possible that the over-estimation is only apparent, and the capital sunk in them did actually amount to Rs. 23,204. But in the case of the Kotla-Chandani Works a very serious over-estimation has clearly been made. The cost of the works was estimated by Mr. Drummond, Deputy Commissioner, to be between 3 and 4 lakhs of rupees, i.e., 2 to 3 lakhs on the Bund and catchment drain and about one lakh on the Chandani Canal. There is nothing to show how this estimate was arrived at, but Mr. McGregor, the District Engineer, whose signature appears at the foot of a statement attached to a report of the 18th April 1893, which contains a note of the estimate, tells us that it was not regularly worked out, that it was arrived at by the method of a very rough guess, and that it includes, in addition to the outlay which may be legitimately reckoned against the Kotla-Chandani Works separately, all the capital sunk by the North-Western Provinces Irrigation Department in all their Bunds and other works prior to 1879, when the works then in charge of that Department were handed over to the District Board. The totals are made up not only of the capital in

the works intended to directly protect the Kotla Jhil, but also in bunds situated in other parts of Ferozepore at a distance from the Jhil and only very indirectly connected with it, and in works undertaken for their own provision. It would appear that the estimate included, besides the Kotla-Chandani Works, the cost (Rs. 4,878) of the Kalinjar Bungalow which had been built for the residence of the Irrigation Officer who supervised the bunds, of the bund at Banarsi which was abandoned in 1877 and never has been and never will be made use of by the District Board, and of the bund at Kaliake, which, though in working order in 1877, was since washed away about 1888 and has now ceased to exist, and also of bunds such as those at Mulapur Nagli and Kanmeda, which are not even noted in the list of works made over to the Board and have never been of any use whatever, having been definitely abandoned before the transfer to the Board took place. The Bungalow at Kalinjar was not taken over as a convenient centre for supervising the Jhil works: it was taken over and has been used simply as an ordinary District Rest House. It was necessary for the Irrigation Department to charge its cost against Irrigation, and when the Department transferred its irrigation works to the Board, it had naturally to transfer also the Bungalow, for which it had no further use. But its cost cannot fairly be included in the Board's accounts against Irrigation. The Board was compelled to take it over without intending to use it specially as an Irrigation Bungalow, and when it came into the Board's hands, it should have been included, for account purposes, with other District Bungalows. Moreover, the cost of the other Bunds made by the North-Western Provinces Irrigation Department, which have never been fit for use since they were taken over or have now been abandoned, even if it should be included in the capital sunk in the bunds of District and cannot be written off as lost, cannot in any case be properly reckoned against the Kotla Bund alone. If the capital sunk in the Kotla-Chandani Works is unduly inflated by including the cost of such works, it will naturally never yield a reasonable profit. The estimate of 3 to 4 lakhs for the Kotla-Chandani works is therefore clearly excessive, and must be checked by a consideration of the amount of earthwork done and the rates probably paid for it.

15. The original plan of the Kotla work was a drain on the up-stream side with an embankment or bund on the down-stream side to turn the floods into the drain. The bund has been somewhat strengthened since it came under the Board's control, but, to prevent an under-estimation, it will be as well to assume that it was of its present dimensions when handed over, i.e., 12 miles long with an average height of 9 feet and a breadth of 45 feet at the bottom and 8 feet at the top. The drain running along the whole of this was in 1869, when Mr. Phelan, Executive Engineer, reported on it in no place deeper than 2½ feet and was generally only one foot deep, being 10 feet wide at one end near Nagina under the Alwar-Gurgaon Hills, and increasing in width to 50 feet at the other end near Ujina. At present there is still an average depth of 1 foot, though the bed has been well cleared out from time to time for earth with which to repair the bund, the whole of the sum of over Rs. 12,000 spent on the bund since 1879 having been expended in taking soil from the drain and throwing it on to the Bund. It is therefore obvious that the deposit of silt is very heavy, and though no definite conclusion can be come to as to the depth at which the drain was originally dug, yet according to observations of the depth of soil taken by Mr. McGregor from time to time, when the bed has been dug up, and from some isolated sections of the proposed work at a few points, which exist in the District Office, the most liberal estimate will not give an average depth of more than about 6 feet throughout. The amount of earthwork in the Bund may thus be worked out as 14,826,240 cubic feet and in the drain as 11,401,800 cubic feet, and the total of these two quantities is 26,228,040 cubic feet. The present average rate for labour supplied by contractors on ordinary earthwork is Rs. 2 per thousand cubic feet, which is probably more than was actually paid when the works were made. We have to remember that the Kotla catchment drain and embankment were originated and probably carried out in part at least during the severe famine of 1837-38, when the wages paid might be expected to be less than the ordinary market rate of the time, that tradition also says that prison labour was largely employed upon them, and that ordinary rates for daily labour have gone up in recent years. Calculated at the present rate of Rs. 2 per thousand, the cost of labour in the Bund and catchment drain comes to about Rs. 52,462. It may have been that a small embankment was also thrown up on the upstream side of the drain, so as to make it a

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canal with raised banks on both sides. Mr. McGregor, the District Engineer, thinks that this was so, and, though the plans of the work are not now to be found as a whole, the plan of one part shows embankments on both sides. But I am of opinion that such an embankment, on the up-stream side along the whole length of the Bund, would be contrary to the scheme of the work, and that at any rate, if it existed—there are no signs of anything like a strong embankment at present—it could not have been made in more than a few places where it was specially required and could not have in general been more than a small spoil bank. We have to add about Rs. 7,000 at a rough guess for the expenditure incurred by the Irrigation Department in planting and looking after trees, and taking this with the cost of the earthwork as calculated by me, we get Rs. 59,462, so that, allowing for error in rates, for the existence of an embankment on the up-stream side and all other mistakes, I do not think that the works could have had more than Rs. 65,000 capital sunk in them when they were taken over by the Gurgaon Board. At that time there were two old sluices on the bund: these were demolished and rebuilt and another sluice was added. The cost of these works, which is added to the capital outlay, was Rs. 3,700, and the total capital of the Kotla Bund may now, therefore, be taken as Rs. 68,700. This is not any under-estimate when compared with the capital sunk in the Gurgaon line of bunds from Jharsa to Madawas, where only Rs. 42,672 have been expended in throwing up 10 miles of bunds, including 10 important masonry sluices and weirs.

16. As to the Chandeni Cut, it is a drain 9 miles in length, 8 feet wide at the bottom, and 24 feet at the top. The spoil was banked up on both sides. This gives 6,842,880 cubic feet of earthwork, the cost of which at Rs. 2 per thousand is about Rs. 13,685. To this we have to add about Rs. 3,000, which is the District Engineer's estimate of the amount spent by the North-Western Provinces Irrigation Department in planting trees along the canal, and making all allowances for errors in assumption of the amount of earthwork and the rates paid for it, the capital sunk in the Chandeni Cut cannot have exceeded Rs. 20,000 when it came under the Board's management. The Board has spent nothing in permanent improvements which could be added to this capital.

17. As far, therefore, as I can form any opinion, the Kotla Bund is now worth Rs. 68,700 and the Chandeni Cut is worth Rs. 20,000, or both together are worth Rs. 88,700. I am aware that I must put forward good grounds for reducing the estimate already made to such a large extent from Rs. 3,00,000 or Rs. 4,00,000, but I cannot understand, more clearly than I have stated above, how that estimate was arrived at or was intended to be defended, and have given my reasons in detail for the estimate I propose. Taking the capital on these works, then, at the figures given, and on the other works at the figures ascertained from the office, which include cost of any permanent improvements such as sluices, spurs, and the like, which have been undertaken, and are apart from ordinary annual repairs, the financial position of the Kotla system of works as calculated by me showed that all works in the system by which the Kotla Jhil is protected and the overflow from the protective works is controlled pay their way except the Chandeni Cut, the Sohna, Raisina-Muhammadpur, Palla and Palri Bunds, and the Malai water-course, and that, if the fluctuating revenue, derived from the Kotla Jhil and divided by Government and the Board, under the arrangement by which the bund management has been made over to the Board, is added to the net profit of the works, then, leaving out of account the few detached bunds, an income of about Rs. 7,331 per annum on a capital outlay of about Rs. 1,44,013 on the bunds and Works accrues, which is at the rate of a little over 5 per cent. There can be no question of the usefulness of works that at one and the same time have improved the sanitary and agricultural condition of the country and the general convenience of its inhabitants and yield a pecuniary profit. Before the Kotla Bund was made, Nuh must have had an almost deadly climate, for, even after it was made in 1838, the tahsil was noted for its unhealthiness, and it has only acquired a better character during very late years, owing to the construction of the subsidiary works which prevent the whole volume of water that is directed towards the bund by the natural features of the land from reaching it. The town of Nuh and the environs of the Jhil are not now considered as unhealthy as some other parts of the district.

18. I ascertained that the miscellaneous income from grass, trees, etc., about covers the cost of establishment on all the works I have above alluded to, and that the cost of annual repairs, which worked out to about Rs. 2,300, bore a percentage of 1.5 to the capital outlay of Rs. 1,54,182. In considering whether the abiana income could be raised, I had a statement prepared to show the average area annually irrigated by each work, and the rates per bigha (the bigha being the kachcha bigha in use in Gurgaon, which = 5.24 acre) at which abiana is now assessed. The statement, however, is not very reliable, as it shows the whole area flooded by each bund, without distinguishing the barani land from that which was assessed as dahri, or flood-irrigated, at Settlement, and is therefore in some bunds unassessed to abiana; moreover, in the case of bunds, such as the Kotla Bund, where water-rates are taken only on lands that have borne a harvested crop, it does not show the irrigated area which was harvested as distinguished from that which bore no crop and paid no abiana. The records in the Local Funds Office are not complete enough to furnish full particulars, and it would be impossible to obtain them accurately from any source. But a rough estimate of the extent to which increase is possible in the abiana returns of each bund can be made, and this will help in the decision of the question regarding each bund, whether it should be maintained or abandoned, by showing in a rough way how much the present rate of abiana will have to be increased all round, in order to make the bund pay. From the figures it may be deduced that it is hopeless to expect some of the bunds to pay, but others can be put on a sound financial basis, and I now proceed to consider the case of each bund individually.

I should recommend the maintenance of all the main Bunds except Raisina-Muhammadpur. The capital invested in these is Rs. 1,30,978. Moreover, the Qabulpur-Maheshpur Drain, which will be mentioned later, is also a work that must be maintained. Some of the works are unproductive and cannot be made remunerative except by assessing on account of them lands benefited by other works of the system of which they form a part and which they assist. Such are the Malai water-course and the Qabulpur-Maheshpur Drain, and the Rawa and Ghata Shamsabad Bunds may also be included in this class. In paragraph 26 below I suggest method by which Rawa and Ghata Shamsabad could be made to pay at least the cost of up-keep, and if this method is adopted, the Board would lose on these bunds only the rate of net income which it may be possible to gain on other bunds. But I would not recommend that this method be adopted. The loss on Ghata Shamsabad and Rawa should, I think, be met from the total income of the whole system of bunds in the same way as the loss on water-courses and drains must be met. This income on the whole system will be derived from an irrigated area that in the past has averaged 56,162 bighas per annum, on which, at present rates and under the present system of assessment, the income has averaged about Rs. 6,050. There will, however, be no difficulty in raising the rates, and the system of assessment might, I think, be altered by exempting lands irrigated up-stream of any bund that were recorded at Settlement as dahri only where special agreements for such exemptions exist; by assessing all other dahri, up-stream or down-stream, at half rates, unless purposely irrigated; by taking the same rate everywhere for both rabi and kharif crops; and by assessing only irrigated lands on which a harvested crop has been produced. If these alterations are made, probably only from 30,000 to 35,000 bighas will pay abiana at full rates. Thus to obtain a reasonable return on the capital invested, each bigha should pay about 4 annas. But on some bunds Rs. 0-5-4 per bigha is paid gladly, and I do not see why this rate, or one very near it, should not be adopted everywhere on this system and throughout the district, as it will not be too high for any bund to pay, and will be readily accepted if the improvements in the system of assessment proposed by me are adopted.

19. On the Sohna Bund the highest rate of abiana that could be applied would still leave an annual loss. The average loss in 1896 on Sohna was Rs. 253 per annum, and it must therefore be considered whether the balance of advantage derived from this bund justifies its up-keep. The advantages of the Sohna bund are described by Mr. Macdonachie as being the conversion of 200 bighas of land into first class dahri and the bettering of lands below the bund by the raising of the well level for as far as two miles below and the moistening of the soil down-stream by percolation. He questioned whether it had injuriously affected the health of the town and decided in the nega-

tive, and I agree with him. To the advantages enumerated by him I would add the lessening of the accumulated drainage flowing towards Indri, Chaudeni, and Kotla, and, as the volume of water held up by the bund is very large, this I would consider an important point. The profit-yielding capacity of the Sohna Bund cannot be increased as things are; but as it is a work that has taken much to build, and is of considerable use in the Kotla system, I would not advocate its abandonment, as long as the whole Kotla system, to the success of which it materially contributes, yields a profit. The rate levied of the rabi, viz., Re. 0-5-4 per bigha kachoha, is that which, I think, should be generally adopted, and I do not see any adequate reason for taking less for water used for kharif irrigation: if the kharif rate were made equal to the rabi, there would be some slight diminution of the loss the Board now suffers, without any hardship on the irrigators.

20. The case of Raisina-Muhammadpur is worse than that of Sohna. The sum lost on it per annum averaged Rs. 215 in 1896. The capital cost of this bund is, I am inclined to think, a little overestimated, but this is a matter that is not capable of proof, and even if it were reduced, the capital would still be so great that no adequate return could be looked for. Mr. Macdonald attributed the small return of abiana to the neglect to charge land which benefited by percolation on the downstream side, but he writes "the direct benefits of this bund are hardly commensurate with its cost." Large expenditure had to be incurred in repairing breaches in 1878-79 and in 1886-87, and the bund was again very badly breached in 1894. It is true that the volume of water held up by it is great, but this water has to travel a long distance through sandy soil before it reaches any of the Jhils, and though by coming down in floods it may damage the Sohna-Gurgaon road in places, this damage can be provided against. The bund has to a great extent become useless on account of very heavy siltage on the upstream side; its height above the level of the surrounding country upstream is now very small: to repair the breach of 1894 would have required a very large expenditure; and the bund could not have been made efficient without raising it throughout. Under the circumstances, I thought that it was one of the bunds that could best be abandoned. The disadvantage of spending more money on it, with an increasing loss of interest, was, I thought, less than the inconvenience which would be caused by flooding from the waters held up by it along their route to the Jhils, and their effect on the Jhils will not be so noticeable as before, now that the system of bunds immediately around the Jhils has been extended and improved. The breach of 1894 was therefore not repaired at the time, and I suggested that the bund be struck off the list of works to be maintained. The capital sunk in it would thus be lost, but it is better to lose this capital once for all than to keep on increasing the loss by adding to the outlay by repairs, and the only real source of income on the bund, viz., the trees, of which nothing has yet been made, but which are worth a considerable amount of money, will not be abandoned by its abandonment as an irrigation work.

21. The Qaisari system of bunds is so intimately connected with the Kotla Bund and the Chaudeni Cut that it is necessary to look at all these works together in considering their financial position. As already remarked, there can be no question of abandoning the Kotla Bund, and the other bunds and the cut, whose main object is to relieve the Kotla Bund, must therefore equally be maintained. The financial position of these works justifies their maintenance. The following figures appear to show the state of affairs in 1896:—

	Average annual expenditure.	Average annual income.
	Rs.	Rs.
Kotla Bund . . .	772	7,288
Chaudeni Cut . . .	340	238
Qaisari scheme . . .	587	1,187
TOTAL . . .	1,699	8,713

The Chaudeni Cut is rather a drainago than an irrigation work, and very little has, I believe, been spent on it in recent years. The recent expenditure has had the object of improving its irrigating capacity, and in future its income may perhaps be in excess of the annual outlay upon

it. As a drain merely connecting two Jhils, it could hardly be expected to pay, but during late years the direction of the flow of its waters has been reversed. The level towards Ujina has silted up, and instead of taking surplus water from the Chaudeni to the Sanged Jhil, it now brings the surplus water of the Sangol Jhil the other way. This fact is somewhat extraordinary, but it has been possible to make use of it by damming up the cut by temporary bunds erected inside it and so holding up its water and spilling it over the high lands along its course before it reaches Chaudeni. Now that the Qaisari scheme protects the Chaudeni Jhil and there is little overflow from it, the Chaudeni Cut can be safely dammed up for irrigation and does not require to be kept constantly open.

The expense of keeping up the Kotla Bund is not heavy save in exceptional years when it is breached, and the danger of breaches and the consequent outlay on repairs can best be obviated by keeping it in constant good repair and increasing the water-way through it where advisable by masonry sluices, which will not only take off the strain from the Luni, but will also allow the water held up by it to be utilized with profit down-stream by irrigation from rojbahas, for which there is some demand. The income from abiana and miscellaneous sources collected by the District Board itself on account of the Kotla bund averaged in 1896 only Rs. 2,305 per annum, but the figure, Rs. 7,288, given above has been arrived at by including Rs. 4,983 per annum which accrues to the District Board as half of the fluctuating land revenue of Kotla Jhil and which is given by Government to the Board on account of its management of the bund. The whole of this fluctuating revenue may perhaps be taken into account here; but even if the Government share is omitted, the District Board share must certainly be credited to the bund, for it is directly due to the Board's maintenance of the bund, and would cease to be realized if the bund were abandoned.

As to the Qaisari scheme, it may be noted that, as the works are new, the figures do not show its financial position in so favourable a light as it is hoped that the figures of subsequent years will do, after the scheme has been completed and has been got into thorough working order. The scheme was started in 1886 and was under construction till 1891. The expenditure of these years, therefore, was debited against Capital, and it was not necessary to spend much on repairs. On the other hand, the works yielded no income. Income began to accrue on them in 1891-92 after their completion, and the amount realised in 1896-98, when they were working well, was as much as Rs. 4,365-8-0. This sum should be fairly well kept up in future years, though of course the income must fluctuate with the rainfall. From 1891-92 to 1895-96 the expenditure on repairs was somewhat heavy, as was natural in works that were new and required consolidation and general improvement. In future annual expenditure should be considerably less than the average of the past few years, and as the works are now fairly established, I believe that they will pay well.

Even as it is, taking the capital invested to be—

Rs. 68,700 in the Kotla Bund,
Rs. 20,000 in the Chaudeni Cut, and
Rs. 17,500 in the Qaisari Scheme, or

Rs. 1,06,200 in all, we have had a return of about Rs. 7,000 per annum which amounts to interest at 7 per cent. This cannot be considered unsatisfactory. And the financial results can be improved by raising the rates and at the same time introducing some changes in the system of assessment which are necessary to remove defects affecting certain villages.

On the Qaisari scheme the rate levied is Re. 0-2-8 per bigha, while on the Kotla Bund and Chaudeni cut it is Re. 0-2-1. These rates can, without any hardship whatever, I think, be increased, except on the Chaudeni Cut, to Re. 0-5-4 per bigha, that which is being paid in some parts of the district and that which I would propose to be assessed in other parts where the present rates are lower. On the Cut, irrigation can only be effected where there is heavy rain and the water in front of the Kotla Bund reaches a high level. Thus on the Cut the irrigation is not so good as that of the bunds, and the assessment must remain low, but I think that the assessment on the bunds can easily be raised. The method of assessing abiana on the Kotla Bund varies, though no authority for the differential treatment of neighbouring villages can be traced, except custom. I would do away with these differences of method, which are unnecessary and give rise to complications, and in altering the rates would give due attention to the complaints of

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those villages which have now to pay abiana on lands, recorded as dahri or Settlement, submerged on the upstream side of the bunds. The payment of abiana on such lands is considered a grievance, even though the dahri rate at Settlement was piled so low as to justify the levy of such a rate. There are, however, villages which are exempt altogether from the payment of abiana on dahri lands behind bunds by agreements entered into at the time of the construction of the bunds. Other villages again, not being affected by bunds, pay for their dahri, which is equally good, nothing but the Settlement rate. But though bund villages having dahri might have had that dahri flooded in ordinary years, whether the bunds existed or not, and though perhaps in years of heavy rain the bunds throw too much water on each land, there can be no doubt that the existence of the bunds improves the dahri and makes crops on it more certain, while year by year our system is being perfected so that control is gained over heavy floods, which are diverted to places where they are wanted, and are not allowed to produce overflowing. The zamindars value the bund water on their dahri, and though it might be argued that nothing should be charged for it, in order that bund villages and non-bund villages should be equally treated in its assessment, I think that the bunds confer a distinct advantage on dahri lands for which we are entitled to charge. But I would take on such lands only half the rate taken on barani lands. The dahri rates adapted at Settlement are about 10 to 12 annas, 14 annas and Rs. 1-2-0 per acre in excess, according to class of soil, of the barani lands for the we take Rs. 0-5-4 per kachcha bigha on barani lands for the benefits of bund water, which gives a rate of Rs. 1-0-7½ per acre, to take half that amount on dahri lands benefited would roughly equalize the assessment, and would not be unfair. When water was especially asked for and given to dahri lands, not ordinarily submerged, through a rajbaha or otherwise, the benefit to the zamindar is obviously great, and he should pay full rates for it. I would, moreover, charge for the benefits of the bunds not only the dahri up-stream, but also that down-stream. Such land benefits largely by the bunds. It still receives as much water as it requires, but the bunds enable very much more of it to be sown and harvested than before, as swamping is prevented. The case of the Khalilpur Jhil may be instanced as an example. The dahri lands down-stream which now bear a crop because of the bunds should, therefore, contribute towards the bunds. But it would be impossible to say in any year what dahri down-stream had been cropped on account of the protection of the bunds, and what would have been cropped even if no bunds existed. I would therefore take a half rate on all lands cropped down-stream of any bund which was recorded as dahri at Settlement. No charge is made at present for the benefits which accrue down-stream from bunds, except in respect of water actually taken from them for irrigation. But the benefit of protection from excessive flooding is undoubtedly a very important one, and should be duly paid for. The lands up-stream and those directly irrigated from the bunds should not be left to bear the whole burden of maintenance. To sum up: the full rate should be charged on all lands, other than dahri, up-stream which actually bear a harvested crop and have been reached and covered by the waters dammed up by bunds, and on all lands, whether dahri or otherwise, which have, at the request of the rajbahas, taken water, down-stream or elsewhere, by rajbahas or cuts from the bund or direct irrigation; on all dahri, up-stream for down-stream, irrigated otherwise, and which bears a harvested crop, half rates should ordinarily be charged. But as I have noted above, the dahri of some villages is exempt by agreements made when the bunds affecting them were built; I do not think we should go behind such agreements, and whenever there is no doubt about them, I would allow them to continue in force for the exemption of the lands to which they related till next settlement, which is not far distant, and at which, if they cannot then be put aside, their effect may be considered in assessment. But only such lands should be exempted as the agreements clearly referred to, *e.g.*, down-stream dahri might be charged, unless the agreement was shown to cover it.

It is difficult to say what the precise effects of the change of rates and system proposed will be on the income from the bunds and works now under consideration. I think that they will increase the income, and at the same time put the burden of the charges upon the right shoulders. In 73 villages affected by the bunds and works in question, there are 82,833 bighas down-stream and 38,834 bighas up-stream which were recorded as dahri at settlement. Of these 57,087 were cropped in 1891-95 and 10,961 in 1895-96, the total abiana realized for all lands in the villages in

question being Rs. 8,622 and Rs. 1,203 in each year. Had the assessment been made according to the system I suggest, the income in the first year would have been six or greater and in the second year it would have been six or seven times as great as that actually realized, in spite of the fact that great relief would have been given to 43 villages by the extensive remission of the heavy abiana which they now pay on their dahri. The real burden of the abiana would have been thrown on those villages and those lands which really benefit by getting good crops now by the irrigation of lands that were formerly not irrigated. Many of the dahri villages suffer great inconvenience by the flooding all round their village sites which they experience—as an instance the case of Chapera, which is an island with dams round the village site to keep out the waters, may be cited—and such villages, I think, deserve more consideration in the matter of rates than barani villages which do not so suffer.

22. In this connection I may point out that certain alterations and improvements in the system are advisable, not only with the object of obviating the heavy flooding round about Chapera, but also with the object of increasing the irrigating power and consequently the income of the bunds. The object to be kept in view is the disposal in all directions, as quickly as possible during the floods, of the waters held up by the bunds. The greater the area over which these waters are spread, the greater will be the evaporation and absorption and the greater will be the irrigated area that eventually comes under the plough. What is wanted is to deepen and improve the existing channels and to lead the water off towards Duraichi, Hansika, and Chausa, where it is required on the one side and has been asked for by the people in the other direction, and towards the present unirrigated parts of Ghatera, Hiranthula, and Mallows, in the other, from the owners of which also requests for water have been received. The overflow towards Shah Chokka also requires regulation, as it at present stagnates in the low lands of Alawalpur, Sakrawa, Papri, Pbalandi, and other villages. In some cases it has caused or accentuated damage from rain, and in all cases it interferes with the Rabi crop owing to the length of time which it takes to percolate into the soil and evaporate. The drain from Mawasi requires to be cleared and extended to Lohiuga Kalan. The work would be costly, but it would be in the end, I believe, very profitable and a number of applications for the extension of irrigation in this direction have been presented by villages that want water. Our efforts should now be directed to bringing the accumulated waters under proper control so as to secure their proper distribution. The amount of water at our disposal can all be profitably used, if carried to the places where it is wanted, and with a proper system of rajbahas it could without difficulty be distributed as required. In all projects for the disposal of the waters behind the Kaiser Bund the importance of using rajbahas as much as possible should not be overlooked, and the three sets of works noted above—*i.e.*, those for the conveyance of the water towards (i) Duraichi, (ii) Mallows, and (iii) Lohiuga Kalan—should all be carried out by rajbahas and channels which will allow of the supply being taken along at such a level as to secure the irrigation of the country from them. I may also add here that rajbahas would be very useful and profitable in some parts of the Kotla and Man bunds, for the irrigation of lands lying before these bunds and their construction would remove complaints of water-logging which have been made by Man, Gandhari, and other villages, which without rajbahas it is impossible to alleviate.

23. The capital invested in Palla is small, but the loss on it is over 2 per cent. The average abiana in 1896 was Rs. 11 per annum at Rs. 0-2-1 per bigha, and the loss to the District Board amounted to about Rs. 36 per annum. This is not great, and as the bund is a help to the Kotla Jhil, I do not think it should be abandoned. I would recommend the enhancement of the rates on irrigation by it to Rs. 0-5-4 per kachcha bigha. The high average expenditure of Rs. 47 per annum in past years, and is not likely to be approached in future years if the bund is properly looked after. It has cost nothing since 1890-91, and should yield a fair profit in years to come.

24. The next bund that requires consideration is Palri. The loss on this averaged Rs. 31 per annum or 18-36 per cent. of the capital cost. The present abiana rate of Rs. 0-2-1 might well, I think, be raised to Rs. 0-5-4 per kachcha bigha. Here also the average annual expenditure

worked out in 1896 was high on account of heavy repairs before 1891-92 just after the Bund was made, and while it was being put into working order, and it is not likely to be again approached. With enhanced rates such as can be easily imposed the Bund should yield a fair profit in future.

25. The Man, Akhaira, Sakrawa, and Shah Chakha works are paying extremely well and require no comment. The two latter are not only irrigation works but serve a very useful purpose as roads in a tract where good roads are much wanted during the rains. To secure uniformity and to provide funds to meet losses of interest and expenditure on the Bunds regarded altogether as one system, the present rate of Rs. 0-2-8 per bigha abian leviable on them might be enhanced.

26. The case of those semi-independent Bunds that I have included in my remarks on the Kotla system may be disposed of at this point.

Ghata Shamabad would, it was expected in 1896, take another 3 or 4 years before the mounds behind it had silted up sufficiently to allow of profitable cultivation, while Rawa would take another 10 years or so. But even though they yield no income and will yield little or none for many years to come, these works cost little to maintain in good repair, and being in reality sand-protection works are not expected to yield any profit. The annual benefit accruing from the Rawa Bund was estimated by Mr. Macdonald at Rs. 500 in Government revenue or Rs. 3,000 to the agriculturists of the country. It would be difficult to assess the lands that, owing to their construction, have escaped the damage from sand which might have occurred to them had the Bunds not been constructed; the amount of the possible damage and the number and situation of the fields which it would have affected would be very hard to estimate, and any cess sufficiently large, or assessed over a sufficiently large area to give a reasonable profit on the capital in the Bunds, levied from lands that were so held to be liable, would be very unpopular. In spite, therefore, of the fact that these Bunds absolutely pay nothing I would not suggest that they be abandoned. The capital sunk in them cannot be recovered by their abandonment, and they are doing good work in their way, though it may never be possible to directly recover even the charges of repairing them. If it is considered necessary that these charges at least, or the charges with the addition of some interest on capital, should be recovered, the only method I can suggest is to estimate annually the amount which it is decided to recover and to call together the blowdars of all the villages protected, and inform them that the sum required must be contributed by them according to any distribution they may determine on themselves. To leave the Bunds entirely in the hands of the zamindars will mean their speedy neglect and abandonment, and if the repairs are kept in the hands of the Board subject to the contribution, according as they themselves choose to pay or not, by zamindars of the sum required, it is probable that the contribution will, in pursuance of a short-sighted policy on the part of the zamindars, be refused. If it is insisted that a certain amount must be subscribed, the zamindars will soon find a way of backing this amount among themselves which will be to all practical purposes fair enough, and will give more satisfaction than any assessment made by the District authorities. If a bachi, such as I suggest, is sanctioned, the amount to be backed could not, I think, conveniently be fixed at the cost of the annual repairs plus any considerable per cent. of interest on the capital outlay, and something much less, probably not much more than the cost of annual repairs, would have to be considered sufficient.

As to Dungeohn, it pays its way and in 1896 yielded 5-11 per cent. interest on capital, after deducting all charges paying Re. 0-6-4 abiana per bigha, and nothing more need be said about it.

27. The consideration of the second system—that for the protection of the Najafgarh Jhil—is not so complicated as that of the Kotla Jhil system. The Najafgarh Jhil is only partly situated in Gurgaon and lies chiefly in Delhi. Like the Kotla Jhil it is a hollow receiving drainage from all four sides, and without any natural outlet till it fills up to a certain point. A canal has been constructed to carry off a great part of its waters towards Delhi, but, even when this is acting to its full capacity, in heavy rains there is still a very considerable area that remains unutilized during the whole year from the effects of water-logging. As far as the Gurgaon District is concerned, the only drainages which the Jhil receives are those from the hills between Delhi and Gurgaon, coming down from Gawalpahari and Ghata by the Badshahpur Nallah (the watershed sep-

arating the Kotla drainage from that of the Najafgarh Jhil being, as before noted, a few miles from Badshahpur), from points further to the north-east by nallahs running past Jharsa, from the north-east slopes of the Taora plateau, and from the north and west sides of the Bhadosi hills. The Subibi Nallah and its affluents, the Indori and the Kasanti, also discharge into the Jhil, though the Kasanti Nallah has been banded up throughout its course in Jaipur, so that it has practically ceased to flow into Gurgaon, even in wet years.

28. The first attempt to check and utilise the drainage towards the Najafgarh Jhil in the Gurgaon Tahsil was made in 1880-81, when the Jharsa Bund was constructed as a famine work. It held up a certain amount of water, but being isolated and situated on the less important lines of drainage did little to relieve the Jhil, and the area flooded behind it was considerable. In 1884 the Ghata and Gawalpahari Bunds, which had been constructed at some earlier dates, at Gawalpahari within the range of hills and at Ghata where the main drainage issues from the hills, and were at that time in absolute disrepair and of no use whatever, were repaired and reconstructed. The former, though situated in the Gurgaon District and under the management of Gurgaon, is not financially included in the Gurgaon list of Bunds. Delhi is responsible for all charges and takes all the income, because the Bund is just on the border and the area flooded by it is all, except a few acres, in Delhi. It is indisputable that Gurgaon should manage this Bund, as it is intimately connected with the Ghata Bund. If Gawalpahari were not kept in proper repair to hold up the waters at the head of the drainage, the Ghata Bund, which has been constructed to hold up only the drainage that collects between it and Gawalpahari, would be in serious danger, and even helped as it is by the latter the accumulation of water behind Ghata occasionally—as in 1894—gives rise to grave apprehensions, and that though the Bund has been lately much strengthened. When the Bund is full, the sheet of water behind Ghata is enormous. It is 4 square miles in extent with a depth at the deepest part of 22 feet and an average depth of 3 feet. Gawalpahari has about the same or a little less capacity, and it needs no remark to show what a serious calamity it would be if the rainfall accumulated behind both or either of these Bunds were to burst forth and devastate the country below. A breach at Gawalpahari in 1875, when the Bund did not hold up so much water as now and when there was practically no Bund at Ghata, had its effect as far down as the railway line, about 15 or 16 miles off, and swept it away. The importance of keeping these Bunds in good repair is, therefore, obvious, and the beneficial effect on the Jhil of keeping out the vast amount of water which they hold up requires no comment, as the Jhil, even without this water, is water-logged; and it must be remembered that this water, instead of running to waste and doing damage, now does duty in affording irrigation and creating soil by silt and securing crops in the villages where it is used. The drainage is regulated by the two Bunds, so that flood irrigation is afforded to the lands behind them, and then each Bund is emptied in succession so as to make its surplus water available for irrigation in the level lands below the hills. But till lately the water allowed to escape did little good beyond flooding a small area of land along its direct course to the Jhil by the Badshahpur Nallah, along which there was no regulation of the flow. In order, therefore, to make some use of it, the Badshahpur Bund was constructed in 1897. This afforded flood irrigation in Badshahpur, Medawas, and neighbouring villages, though it still left unsolved the question of fully utilizing the water held up, as the discharge from it simply went straight to the Jhil as before. But Jharsa runs badly in want of more water, as the Nallahs feeding the Jharsa Bund were incapable of bringing down as much water as the Bund could profitably use, and the Bund itself was capable of much development and able to cover a very much greater extent of cultivated land by an extension. The Gurgaon Training Works were, therefore, taken in hand. These connected Jharsa with Medawas by a continuous Bund with the object of leading the surplus water of Badshahpur through Ghansaula, Fatehpur, Islampur, and other villages into the Jharsa Bund, thus increasing the area flooded by causing a greater sheet of water to be dammed up behind it, and irrigating lands between Jharsa and Badshahpur by causing the water in its course along the Training Works to spread by being dammed up by a series of spurs or embankments jutting out from the Training Works. The water collects till it gets round the head of enchapur, and when no more remains to be sent down the space covered by what is dammed up by reason of the

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Band and the spur is cleared by opening sluices were such exist, or cutting the spur close to its junction with the Band. Even after these works were constructed, it was found that a large quantity of water had to be allowed to escape from Badshahpur without benefiting any lands except those along the Badshahpur Nallah for flooding which the natural levels were convenient; damage also continued to be caused by the water in Garhi Harsara, Chandra, Budhara, and other villages near the Jhil. To check this waste the Fazilpur Band and Spur was constructed in 1890 some distance below Badshahpur upon the Nallah. But the real improvement of the system hinged upon the development of the Training Works, and a power over the accumulations behind the Bands which had never been availed of before was obtained by putting sluices into the Training Works and throwing out distributaries from them on the down-stream side, and finally by connecting the Medawa Basin with the Training Works by a short cutting of 5 or 6 feet depth. This allowed of the utilization in the Works and their rajbahs of the water which the rise in the ground had before prevented from being thrown into them and which had perforce to be spilled into Fazilpur. Fazilpur need only a little of the spill, so that the greater portion was still wasted and caused damage on its way to the Jhil.

29. The system in 1896 was, I thought, except with regard to the need for more rajbahs, as nearly complete as it need be, and it was, in my opinion, capable of utilizing every drop of water caught in all the Bands, even in wet years, without allowing any water or damage whatever down the Badshahpur Nallah or in the basins of the Bands themselves. The rajbahs lately introduced are particularly useful, and I would recommend that rajbahs be made wherever possible on the Band and all other Bands. Without rajbahs irrigation down-stream can only be effected by cutting the Bands or opening out sluices and letting the water run over the land in front without control. This system is very objectionable and wasteful. It is under it impossible to let out the dammed up water till the land over which it will flow in front has been cleared of crops and is ready to receive it. Hence the water has to be held up till the fields up-stream are over-irrigated and the water cannot be let out gradually, so as to allow the higher fields to be brought under the plough as early as they might be. Moreover, the indiscriminate flooding in front directly the Band is opened forces water on to some fields where it is not wanted, and it is also complained against on the ground that it washes off manure from the fields in which it has been deposited. But when down-stream irrigation is done by rajbahs it is under absolute control. No one need get more water than he wants, the manure deposited in the fields soaks into them and is not washed out, and irrigation can be commenced as soon as there is any demand for water at all down-stream. A very large quantity of water can thus be let out before, under the old system, it would have been possible to open the Band at all, and in this way pressure on the Band is relieved while the lands behind it are rendered available for cultivation as soon as possible and the discharge of the accumulated water is completed methodically and early. The zamindars highly appreciate the advantages of the rajbahs over the old system, and freely and willingly give land for the construction of them. Further improvements required in 1896 were the extension of rajbahs, of which only 10 miles existed when I left Gurgaon, and the digging of a toe drain along the Band from the Jharsa since furthest to the north so as to throw the floods on to Salokhara and the eastern part of Gurgaon. The continuation and strengthening of a spur round Dhokar was also desirable so as to relieve the Training Works where they are weak, and command somewhat high-lying land that wants water, and to throw the water more conveniently into the channel between Islampur and Jharsa. The provision of more sluices and their better regulation was also a desideratum; and finally the Ghata Band required to be strengthened and to be protected by a small spur against the backwash from the channel by which its waters escape. In addition to the direct irrigation benefits of the Jharsa and connected Bands, a very important indirect benefit has been observed in the increase of the water level of wells and the increased certainty of their water-supply. It is therefore important from all points of view to improve these Bands and keep them in good order. The whole of the improvements in the Training Works which I have mentioned would be generally beneficial, and, I believe, financially profitable.

30. The profit and loss on the Gawalpahari Band is, as

I have said, accounted for in the Delhi District, and I had no figures available for showing its financial condition. On Jharsa the capital is probably much over-estimated. In handing over the band the Public Works Department put it down as Rs. 21,226. Mr. Macnachie says: "This enormous expenditure represents the liberality of the Government rather than the actual amount of earthwork done, which I should think well paid at Rs. 10,000." There are, however, three masonry weirs, in addition to the earthwork, and these must have cost about Rs. 1,500 each. The Band, therefore, might probably have been built within Rs. 15,000. But it is difficult to say what the original works were, and the Band has been so altered and extended that there is no means of correctly checking the Public Works Department figures, which probably also include compensation for lands purchased, and I would not propose that they should be revised. The amount said to have been expended must be taken to have been expended, and though it is unfortunate if it happens that the Band suffers by an over-estimation of its capital on account of lavish expenditure or waste during its construction, the best that can be done under the circumstances must be done.

According to the figures resulting from the working of the Ghata Band and Gurgaon Training Works in the past—excluding Gawalpahari—the District Board appeared in 1896 to have been annually losing an average of Rs. 433 and Rs. 100 on each of these works, and on the present capital of Rs. 52,152 sunk in them, this equals 1.02 per cent. The Ghata income cannot expand much without altering the rate, and the average since the Band was taken over by the District Board gives Rs. 120 per annum abnina, but the income was Rs. 162 in 1891-95, and Rs. 261 in 1895-96, a bad year, the water in the latter year being forced up higher because it could be held up longer on account of the improvement in the Training Works. The appointment of special Patwaris to check irrigation also improved the returns by ensuring that all land on which abnina was due was properly assessed. The abnina to be expected from this Band in future should not be less than at least Rs. 200, even at present rates.

The improvements that I effected in the Badshahpur Jharsa Bands by the Cut from Medawa to the Training Works, the lengthening of the Dhokar Spur, new sluices and rajbahs—which cost Rs. 3,650 in all—can be estimated from the fact that the Badshahpur and Jharsa Bands with the Training Works in 1893-94 gave Rs. 1,053, in 1894-95 Rs. 1,594, and in 1895-96 Rs. 2,492, in spite of the fact that there was very little rain in the latter year (19.76 inches at Gurgaon), whereas the former two years were years of good rain (23.41 and 33.27 inches). The works in 1895-96 suffered very greatly for want of water, and, had the water been available, I think I am well within the mark when I say that I might have doubled or even trebled the income. In future years the works, even at the present rate of abnina, should never yield less than Rs. 2,500 in even the very worst year, which is 5.85 per cent. on the capital even as at present estimated. In good years they should yield 10 per cent. with ease. To this must be added at least Rs. 150 per annum for the proceeds of pulas, wood, etc., on the Training Works. The average for 17 years gives Rs. 124 per annum, but this source of income has been much developed, and it will be necessary for the protection of the Bands to cut down much timber on the inside, trees being planted on the outside in exchange.

The total income from the Ghata Band and the Training Work system should thus in the worst years be at least Rs. 2,850 or 5.42 per cent. on the capital. In average and good years it will be very much more. The average annual expenditure in 12 years before 1896 has been Rs. 1,287 per annum or 2.47 per cent. The expenditure in future years will never come up to this—in fact, there was no expenditure required for 1896-97, and the cost of maintenance should never exceed 2 per cent. of the capital. At Ghata the present rates of abnina are Rs. 0-2-8 per bigha kachcha on rabi crops and Rs. 0-1-4 on kharif; on the Training Works it is nominally Rs. 0-2-8 per bigha kachcha on up-stream irrigation and Rs. 0-1-4 on percolation just in front of the Band, but since the rajbaha system has been introduced Rs. 0-2-8 has by agreement been taken on percolation and down-stream irrigation as well. These rates can safely be increased, as the new Cut and other arrangements connected with the Training Works will allow the whole of the Medawa Basin, 1,400 bighas kachcha, to be cultivated with sugarcane. On this first class crop at least Rs. 1 per bigha kachcha should be taken and the zamindars are quite willing to pay at this rate. They can grow excellent cane and do not object to the rate proposed, provided that

their Basin is not flooded during the earlier part of the rains. Therefore the Medawas sluices should be kept open till the cause is fairly high. There is no advantage derived from bolding up here the water of the earlier rains, and it is not really necessary to use the Medawas Basin as a reservoir till the Gawalpahari and Ghata water is let down into it about the 1st October. The cause is then high enough to stand all the immersion it gets, even if the Basin is filled as much as possible. These facts should be remembered and arrangements should be made to encourage cane-growing in the Basin, especially if it pays at Re. 1 per bigha. Similar rates should be taken on gardens which are flooded in the village of Gurgaon. No questions regarding dahri arise in connection with the Bunds of the Najafgarh Jhil system, but the assessment of chahi lands has to be considered. I would exempt all chahi lands from abiana, except in cases when water had been voluntarily taken for them—i.e., by a rajbaha or otherwise than by mere flooding. Chahi voluntarily irrigated should pay full rates. When the water stands behind the Bunds, the land is so thoroughly irrigated that it bears a good crop even if the winter rains practically fail, and the irrigation by rajbaha is just about equal to that behind the Bunds, as it has been found impracticable to check the quantity of water that each *masa* takes. Every field is, therefore, soaked to its utmost. In 1905-06 when the winter rains failed entirely the crops on lands before and behind the Gurgaon Bunds and irrigated from them did excellently and were a standing proof of the efficacy and value of their irrigation. It will not be in any way unreasonable to ask all irrigators to pay Re. 0-5 4 per bigha kachaha for the water they get. The Gurgaon system, as it is, is not financially bad, and it may, therefore, be supposed that an increase of rate which increase the abiana income and give a considerable return on capital is uncalled for. But it must be remembered that the rates higher than those paid here are only what are being readily paid elsewhere, that there is no reason to treat the zemindars on this system with exceptional leniency, that the whole of the Gurgaon Bunds must be looked at together, the loss on some being balanced by the profit on others, and that a good profit on the Gurgaon system, when it can be secured without difficulty, will make up for the amount of interest that the Board may lose elsewhere.

31. Bunds at Harwaru, Garhi Harsaru, and Jhund Seraf existed in former times to check the floods making towards the Najafgarh Jhil, but these have been disused for many years and have ceased to exist: practically no signs of works can now be found. They were made by the Public Works Department before 1860-61. Nothing has been expended or received by the Board on account of these works since they were handed over in 1879. The amount of capital expended on them is not known, and though the cost of Garhi Harsaru was put down in the Executive Engineer's list of 1877 just before the Board took over the Bunds as Rs. 3,227, this cannot I think under the circumstances be reckoned against the District Board. The capital outlay was lost before the Board took charge. The Board was in no way responsible for this, and the three Bunds not-d above should be struck off the list without reckoning their cost against the present Bunds.

32. The other works in Gurgaon with the dates of their construction by the Board are the Bunds at Kasan (1834), Naurangpur, Barjugar, Shikohpur (1886), and Manesar (1890).

Kasan is described by Mr. Macconachie as intended to intercept the drainage from the hills east of Kasan towards Farrukhnagar and the Jhil, to flood the lands of Kasan, silt up the nalah and its ravines and render them cultivable, prevent sand deposit on lands lower down, and render wells north of Kasan fuller and less exhaustible.

Naurangpur similarly intercepts the drainage into Farrukhnagar and the Jhil from the hills west of Bhundsi, floods Naurangpur, prevents damage by sand below, and it was subsequently connected with Manesar so as practically to form one Bund with it.

Manesar has a catchment area of 6 square miles, floods the village land, and protects Dhorkn and Mesha from sand deposits.

Barjugar had a Bund originally constructed by the Public Works Department and handed over to the Board with other Bunds. But this silted up so as to be ineffective and the present Bund was therefore built. As the Public Works Department Bund was useless when handed over, I would not reckon its capital cost against the pre-

sent District Board Works. The waters of the nalah intercepted by the Bund flowed down to the Jhil.

Shikohpur intercepts the waters that in their course to the Jhil did considerable damage by sand deposit in Palra, and among its other objects Mr. Macconachie notes that it was intended to bring more water into a tank situated just behind it.

It will thus be seen that, though all these Bunds intercept drainages flowing into the Jhil, they are not primarily Jhil protection works. They do not exercise more than a very slight influence upon the Jhil, as before they reach it, the waters intercepted have a long course to pursue. They are all works intended mainly for the irrigation of lands in the villages in which they are situated and for the sand protection of the villages below them. In my opinion the damage caused by the free action of the waters held up by them does not justify their maintenance unless they are commercially profitable. But a consideration of the figures shows that each of these Bunds is kept up at a loss, which on an average of years amounted in 1890 to the following sums, bearing the percentages shown to the original costs of the works, viz. —

	Per cent.	Rs.
Kasan . . .	17-12	199
Naurangpur . . .	1-21	14
Shikohpur . . .	1-30	9
Barjugar . . .	2-31	24
Manesar . . .	5-47	101
		<hr/>
		Rs. 347 per annum.

33. The only method I can suggest for the maintenance of these Bunds, with a hope of deriving any profit from them, is to fix the rate of interest, at which the Board is entitled to a return on its capital invested in them, and to work this out for each Bund, and every year to add to it the sum necessary for annual repairs. The total thus obtained for each Bund separately should be announced to a *panchayat* of all villages concerned in that Bund. If the *panchayat* thinks that the maintenance of the Bund is an advantage and is willing to pay for it, they should be asked to *bachh* the amount among themselves. They will best be able to distribute the demand over the various villages and land-holders concerned on such estimation of the advantage that each obtains from irrigation, deposit of silt, prevention from damage by sand, etc., as they may elect to adopt. Such a distribution could never be made satisfactory by a Revenue or District Board official, but villagers could make it if they wished to do so. If they elected to make it, the *bachh* agreement should be taken from them and the Bund kept in repair by the Board:—otherwise the Bund should be abandoned and the capital struck off as irrecoverable. To keep up these works, unless they pay, would be to throw good money after bad, for the objects they serve are of almost purely local advantage and do not justify the taxation of persons other than those living in the locality benefited. But if any of these Bunds is abandoned by not being kept in repair under the Board's supervision, I do not think that the levy of rates on all land irrigated should cease, as long as the Bund by whomsoever repaired continues to irrigate. Repairs, however, should not be undertaken by the Board, so as to gradually allow the Bund to fall out of use. Otherwise the zemindars might refuse to *bachh* the amount required, and then waiting a year or so after the Bund had been definitely abandoned proceed to repair it themselves, and thus escape all rates, but as the Board's capital is invested in the Bunds this should not be allowed.

34. To prevent any chance of this and also as a step towards doing something to recoup the Board for the heavy loss already sustained by it, not only should rates be continued to be levied, but it should also be laid down that in case the amount required for interest and repairs was not voluntarily *bachh*ed, a higher rate than that now in force should be taken. The rates on these Bunds at present are chiefly Re. 0-2-8 per kachaha bigha, but on the Manesar Bund twice this rate is paid. There are, however, considerable differences in the conditions of assessment. For instance, lands down-stream of the Naurangpur Bund pay half rates, while they pay nothing at all on the other Bunds, and on the Barjugar Bund only the harvested area is assessed, though on the other Bunds the assessment is imposed on all the area submerged up-stream. I cannot

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understand how these differential rates come to be fixed, and I think that they can in no way be justified. The condition of all the Bunds is exactly equal. They all lie in the same part of the country close together. The objects of all are exactly similar. If, therefore, four of them can justly be assessed on all submergence, why should the submergence in Barjogar which has borne no crop be exempted? If down-stream irrigation in Naurangpur is justly assessed, why should it be exempted in the other Bunds? There is, it is true, very little down-stream irrigation, but we want all the income we can get and should assess all there is. As Muncsar pays Rs. 0-5-4 per bigha kachcha, all can pay the same, but even this taken on all, including Barjogar, on all submergence, will still give only about Rs. 220. I would not, however, raise the water-rate above Rs. 1 per bigha pakka harvested (which is the same as Rs. 0-5-4 per bigha kachcha), and in case the zemindars refuse to take on the Bunds on the terms suggested in the preceding paragraph all we can do is to raise the rates all round to Rs. 1 per bigha pakka harvested on flood and 8 annas on down-stream irrigation and percolation, to spend nothing in future repairs, except of the simplest character, to keep on the works, which are now in good repair, in this way for as long as they continue to yield anything at all, and finally to abandon them. The accounts of these Bunds should be kept separately.

35. The Dhulawat Bund is situated in the Tauru piteau and with the Tauru Bund and the Tauru Road, which operates as a Bund, regulates the drainage of the Indori Nalab, mentioned above as an affluent of the Sahibi. In so far as these works check the floods of the Sahibi they are works which operate for the relief of the Najafgarh Jhil, but they are not primarily intended for this object and so really works which have only the object of benefiting the villages in their immediate locality. They may, however, be conveniently discussed in succession to the works directly connected with the Najafgarh Jhil.

36. The Dhulawat Bund was made in 1884. Its object is to cause the nalabs behind it to silt up so as to increase the cultivated area of the villages on which it throws the rainfall of the 5 or 6 square miles which are its catchment area. Judging from the experience which we had of the work in 1896 I was of opinion that it could never attain this object with any hope of giving sufficient abiana from the lands created by it to pay its way. The annual excess of expenditure over income was Rs. 78, and this represents 1.29 per cent. on the capital cost of Rs. 6,014. Water-rate is levied at Rs. 0-2-8 per bigha. The figures of collections for past years show no increase in area due to silting, and even to make good the annual loss of the District Board an increase of 468 bighas is required. This cannot be hoped for in less than 10 years, if even then, and as it is too large a work to be entirely abandoned the Bund is one that must be worked at a loss unless the rates levied on it are altered. The average actual realisations of abiana are Rs. 81 per annum. To give a reasonable return in the shape of interest the present abiana rate would have to be raised higher than it is practicable, but if it was doubled and raised to Rs. 0-5-4 per bigha, the income would be just what is sufficient to meet the annual expenditure, and the Board would not be out of pocket, though it would lose the interest which its capital ought to bring in.

37. Tauru Bund was one that had been made by Sattar, zemindar, and was purchased by the District Board in 1892-93. After the purchase the expenditure on repairs was great, but the Bund has been put into good condition and should not require any extraordinary repairs in future. Abiana in 1896 have been levied for only two years and showed a tendency to increase, having been Rs. 143 in 1891-95 and Rs. 394 in 1895-96, and on an average the District Board had lost Rs. 117 per annum on this work, but the number of years during which the Board had had it, was not sufficient to allow of a fair average being struck. Not more than Rs. 200 per annum should be required for repairs, while the abiana—considering the figures it reached in the very poor year 1895-96—should be at least Rs. 450 annually. Jhond (elephant grass) had been planted over the whole of the land and was doing well. The income from it should shortly amount, to Rs. 50 per annum. There will thus be an estimated profit of Rs. 300 per annum on the Bund as a whole, which gives 8 per cent. on the capital outlay of Rs. 3,805. The rate levied is Rs. 0-2-8 per bigha by agreement. No objection has yet been obtained for the collection, but the Bund is very popular and the people are anxious to get

water. Considering the loss the Board has already suffered in the past, the loss in interest that it must suffer on the Dhulawat Bund, and that the unification of rates is desirable, I would suggest that the rates to be levied on this Bund in future should be fixed at Rs. 0-5-4 per bigha.

38. The Tauru-Jatauli Road is an important trade route connecting Tauru with the Rajputana-Malwa Railway and is regarded as a feeder road. An expenditure of Rs. 17,211 has been incurred in making it since 1891. It was not intended as a Bund, but owing to the nature of the country it has had to be raised and has, therefore, acted as a Bund. The rainfall which formerly flowed down into Bahora Pataudi, *via* the Indori, is held up by it and floods a very considerable area of cultivated land. The zemindars were asked to pay abiana on account of the advantage (but thus accrued to them, and I, on a visit to Tauru in the autumn of 1895, saw all those who were interested and discussed the matter with them. They expressed their willingness to pay on all lands except those irrigated by wells. Their fields had been flooded only in 1895-96 and 1891-96, and eventually an agreement was come to with them by which it was arranged that they should for the two years in question pay Rs. 0-1-4 per bigha for the first year and Rs. 0-2-8 per bigha for the second year for all Bund irrigation, except that of chahi laod. The abiana thus levied amounts to the very considerable sum of Rs. 855. The irrigated area is capable of very great extension by throwing out spurs on the up-stream side and constructing rajbahas on the down-stream side. I would suggest that between the second mile from Tauru and the sixth mile from Bahora—7 miles—half the cost of the road be reckoned as capital expended on irrigation works, and half the annual repairs be counted against Bunds, the other half being reckoned as expenditure on communications, and that all expenditure on spurs and rajbahas and purely irrigation works be also debited against the former head. Taking the figures of 1896, the capital cost of the work as an irrigation work, would thus be Rs. 8,514, and the return of Rs. 855 for two years gives an annual profit of 4.04 per cent. To secure uniformity, however, and a sufficient return of interest to cover expenses as well as give interest, and also to cover the loss of working expenses and profits on other irrigation works, I would suggest that in this work also the same rate be taken as I have proposed for the other Tauru Bunds and also for Bunds elsewhere, and that abiana be levied at Rs. 0-5-4 per bigha. It is difficult to estimate what this would yield, but in a good year it should give at least Rs. 1,000 and in bad years not less than Rs. 500. The whole of the road has been thickly planted with jhond, the success of which is chiefly dependent on the water supplied by the road as a Bund. The annual income from this jhond should not be less than Rs. 50 for the first three years, increasing later, and half of this should be credited to the road account and half to the Bund account.

39. All the Bunds in Rewari were upon the Kasauti Nalab and all have been abandoned. Bunds existed at Dahina, Nandranpur Bes, Zainabad, Bihari, and Khol, but the Board has expended nothing on them except Rs. 130 spent on Khol in 1886-87 and 1887-88. The works, except Khol which was made by the District Board in 1885-86, were originally in charge of the Provincial Public Works Department, but were practically abandoned before the Board was vested with their management. In 1896 the Board derived no income for them except as follows:—

	Rs.	Rs.	Rs.
Dahina	93 4 7	94 5 10 0	95 6 ...
Nandranpur	8	8 8	...
Zainabad	8	2 0	...

These items were realised not as abiana but on account of the sale of windfalls and grass, as the land on which the Bunds stand belonged to Government. Bihari has given no income, and the site of the Khol Bund belongs to the zemindars. The capital outlay on the Rewari Bunds is not known except as regards Khol, in the construction of which the Board spent Rs. 1,885. The necessity for the Bunds has ceased with the drying up of the Kasauti Nalab, and they are now never filled and cannot be profitable as irrigation works. I, therefore, suggest that they be all abandoned and the capital expended on them be struck off as lost.

40. I have now left to notice only the Chahna Bund and the Qabulpur-Maheshpur Drain. The former was a purely protection work situated in the Delhi District, and

intended to divert the Jehri Nalah, which was causing damage to the Palwal Khadar, into the Jumna at its head. This nalah flows out of the river near Chaina and flows back again into the river lower down in Gurgaon. The worst of the Palwal Khadar villages have their lands in the island formed between the Jumna and the loop of the nalah. The Bund was made without any object of yielding direct revenue. It is, however, unnecessary to say anything more about it here, as the Jehri refused to be diverted, but disposed of the Bund by sweeping it away. The capital expended in making the dam—Rs. 1,690—and Rs. 398 expended during two years in its repairs are lost. It is useless to think of putting another Bund in its place or of making any use of the remains of the old Bund, and the expenditure should be written off.

41. The Qabulpur-Maheshpur Drain was dug with the object of relieving water-logging in villages of the Delhi District in the Ballabgarh Tahsil adjoining Harpalala in the Palwal Tahsil. Its object is to throw surplus water from these villages into the parts about Chaina in the Nuh Tahsil of Gurgaon where water is wanted. This Chaina is distinct from the Delhi Chaina mentioned in the last paragraph and should not be confused with it. With average rainfall the water lodges near Dhatri, soon after it enters the drain, about 5 miles from Qabulpur. In settling the level at which to dig the drain it was purposely decided not to take the water along at a lower level and it was intended to leave it to work only in heavy floods. No floods capable of working the drain have as yet occurred, since it was made in 1891-92. It is a matter for congratulation that there is no expenditure on repairs. The Delhi District was in 1896 contemplating an improvement, and I was of opinion that if a dike with high banks were made through the hollows about Dhatri and Maheshpur, where the water now lodges, there can be no objection on the part of the Gurgaon District, and if water is thrown on to Chaina so as to benefit its cultivation the District Boards of Gurgaon should be authorized to collect abiana at the rate of Re. 0-5-1 per bigha as some retain for its outlay of Rs. 1,133 on the Qabulpur section and Rs. 7,118 on the Maheshpur-Chaina section of this work, which can never be expected to return any profit.

42. I believe that the Bunds can be efficiently managed by the District Board, whose District Engineer, Mr. McGregor, is thoroughly acquainted with all the works and knows how to manage and improve them. Their maintenance is absolutely necessary, and there is no practicable way of maintaining them except by the agency of the Board. Their financial position has been represented as much worse than it is, because large expenditure was incurred in a few years on works, such as the Qalari system, which will undoubtedly be most remunerative and useful in the future, but require time to develop. The orders of Government now prohibit the undertaking of new works without the Commissioner's sanction, and in the case of large works that of the Financial Commissioner, and there is, therefore, no fear that in future reckless expenditure will be indulged in. Such expenditure, however, as is incurred, will come out of the ordinary income of the Board, to which all Bund income is credited, without being kept distinct from the other income of the Board. A distinction is unnecessary, though a separate statement might usefully be kept to show what is spent on the Bunds and what they yield annually. This would indicate the works which could best be improved, and the amount which the Board might spend on Bunds, though its expenditure need not be confined to the surplus derived solely from the Bunds. The results of the Bunds as a whole should, I think, be looked at, and, as long as all the Bunds together yield a satisfactory profit, exception need not be taken to the maintenance of one or two unremunerative works which are useful in their own way. Expenditure on repairs may, I think, be undertaken by the Boards without the sanction of higher authority, and the orders of Government have been understood to mean this. It is, however, often difficult to draw a line between repairs and improvements resulting from them, as, for instance, where a small railway is constructed in connection with the repair of a sluice, and I found that orders were required as to the exact limits within which the Board may spend money without previous sanction of superior authority.

43. The system, under which the Bunds have been looked after by Mohitamins remunerated by a percentage on the collections, is one that would serve its purpose well enough if the Mohitamins were good men. But I found them so only in exceptional cases; e.g., in that of the late Chaudhri Umrao Khan, of Sohna, who was of the greatest

assistance. The average Mohitamin is not very interested or energetic in his work. He should be continually on his Bund, reporting what repairs are required and the general state of affairs, and he should also have influence over the zemindars whose lands are affected by the Bund sufficient to prevent them from opening sluices or cutting breaches, in order to clear off the waters dammed up-stream or to get irrigation down-stream. Breaches cause great loss and inconvenience to the Board, and it is most often impossible to decide who is really responsible for them. The Mohitamins should also interest themselves in planting jhund grass on the Bunds and trees on the down-stream side; if trees are planted up-stream, they are liable to prove a source of weakness when the Bunds are full. The income from jhund and trees is not inconsiderable and is capable of much development. Finally, the Mohitamins have to see about the collection of abiana, and, in many cases, have given little help, so that abiana has been outstanding for years. I think that Lambardars might be made use of, and that if the stretch of Bund in each village is put under the charge of the Lambardar of that village it will be well looked after, especially if the establishment of Bund coolies is strengthened when necessary; but I need only say here that the matter requires consideration.

44. As to fees, there have not been foregone because they have in some cases not been notified. They have been collected by private arrangement with the zemindars. It is, however, necessary now to put matters on a more satisfactory footing. I understand that it is unnecessary to put in charge of the District Board by formal notification, works it has constructed itself after the date of Punjab Government Notification No. 34, dated 14th September 1899, which enumerates the works put in charge of the Board, and there are no village Bunds which the Board requires to manage. Notification No. 34, therefore, requires no alteration, and the alteration of Notification No. 33 of the same date, fixing fees, will be a simple matter. There can be no doubt that, with the sanction of Government, the Board is entitled to charge fees for all the works which are to be maintained, and at reasonable rates not only the Kotla Works, but all the works worth keeping up in the district will return fair interest in addition to working expense. The Notification amending No. 33 need only detail all these works, and state that the general rate for irrigation will in future be, say, Re. 0-5-1 per acre, except in the case of dabri lands exempted by agreement, and of other dabri lands which will pay half rates, unless voluntarily irrigated by rajbharas or otherwise. Chahi lands should also be stated to be exempt unless voluntarily irrigated, and special rates, Re. 0-2-1 per kachcha bigha on the Chaudhri Cut, and Re. 1 for sugarcane and gardens on the Gurgaon Training Works, should be noted. It will also be necessary to notify the barch arrangements proposed for Ghata-Sham-e-lad and Slawa, if they are to be introduced, and for the Bunds named in paragraph 32, it being added in the case of the latter that if the money required is not booked fees will be collected at the ordinary rates.

It is very important that the abiana should be levied from the whole of the lands liable, and I believe that the Board has lost a lot in the past from this not being done. It is also important that the abiana parchas should be prepared with as little delay as possible, and that persons charged should be given an opportunity of objecting to improper charges and clearing up doubtful points, and should then be made to pay up promptly in full. This is impossible if, as I found to be the case, charges were not made out till long after the harvest for which they were due, and I would invite attention to an order passed by me, by which I tried to reduce things to a proper system. The entertainment of special Patwaris for Bund work is necessary in order to get accounts settled promptly.

45. The Kotla Jhil contract with Government, by which the fluctuating revenue of the Jhil is shared by the District Board and Government, should, I think, be continued for an indefinite period, or at least till the next settlement. This contract is worth a good deal to both parties. It gives the Board very considerable assistance, with which it can hardly dispense, and it has resulted in the improvement of the Kotla works and the consequent increase of the revenue which goes to the share of Government. A return showing the amount of this revenue, and of the suspensions and remissions in so-called "submerged" villages, which were put under special rules of remission at settlement, might usefully be kept up specially to show how useful the Bunds are to Government. There are also some other directions in which they are useful, and record of their results would be of interest, for instance, in showing their effect on the surface level of wells. The only figures I have seen about

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this relate to Jharsa and the Civil Station, and these show that the level of the water in the wells, which is about 25 feet from the ground surface, has risen from 1 to 1½ feet. The Dholmat and Sobna and other Bunds, I am informed, have produced a great effect in this direction, and simultaneously with the raising of its level the quality of the water is improved, so that this is no slight benefit for which the people are indebted to the Bunds.

46. Most of the Bunds, including all the important ones, except the Jharsa and Kotla Bunds, stand on village lands not owned by Government or the Board. Inconveniences result from this, as the villagers occasionally complain that they are deprived of the use of their lands. Had it been thought of to acquire the land on which some Bunds hold up their water, particularly the basins at Gawalpahari, Ghata, and Medwana, before they acquired value through the Bunds, the income of the Bunds would have been very largely increased by the possibility of holding up water and distributing it only when required, without any waste such as now occurs, when we have to empty the reservoirs in order to suit the impatient owner of the land up stream, who wants to have his fields free from flood before the fields down stream are ready for irrigation. The buying up of the reservoirs is now, I suppose, hopeless, but, in order to have as complete a control as possible over all its works by the District Board, the lands on which such works are situated should be acquired, or, if this is impossible on account of its cost, arrangements should be made to get the zemindars to formally acknowledge the right of the Board to retain possession as long as necessary on paying revenue and rent or otherwise. The rajbahs that have been recently constructed are all in village lands, and the villagers are glad enough to give lands for the purpose. But the Board should be able to exercise permanent control over rajbahs which it makes, and some agreement is necessary in taking over lands for their extension—which, in my opinion, is the most useful and remunerative direction in which the Bund system can be improved. The extension of rajbahs should be kept constantly in view, as they enable the best and most convenient use to be made of the waters drained up. If they are properly worked, for instance, in the Bunds round villages like Chhapra, they will do much to obviate the complaints of over-flooding which are often made and they will stop the Bund-cutting to which the up-stream villagers sometimes resort in order to rid themselves of the water standing on their lands, and thereby causing much damage and expense and bringing down punishment on themselves. There is, I believe, considerable necessity for rajbahs in the locality named just above, as well as inside the Kotla Bund, towards Dazachli, and all along the Gurgaon Training Works.

47. The District Board, as shown above, can obtain a profit from the Bunds, while they at the same time benefit not only the land-owners who irrigate from each Bund, but also those—it may be at a considerable distance from the Bund—whose lands are protected from excessive flooding, and in some cases serve as roads. There is thus no financial

objection to the Board undertaking these works and applying District Funds to them. All projects, however, for new Bunds require to be very carefully worked out, but new Bunds that have been thoroughly considered (so as to obviate errors which have been made in the past, such, for example, as the location of a Bund in a position where it is bound to render a village-site during the rains an island and practically uninhabitable) and such extensions of rajbahs leading from Bunds as the District authorities find desirable, can be recommended as Famine Works, consisting as they do mainly of earthwork and providing work for the people near their homes. Bunds, it is true, cannot be so successful in dry as in wet years, but the experience of Gurgaon shows that they are valuable even in dry years. The Board in my opinion is the best authority—under the control of the Deputy Commissioner—for managing and controlling the works, improvements in detail of management being made if they have not already been introduced, and the rates leviable can be collected by the Board either by law (which is preferable) or by agreement.

48. To sum up, I think that the District Board should be granted a continuance of the Kotla Jhil contract for an indefinite period; that certain Bunds, viz., Raisina-Muhammaddpur and those mentioned in paragraphs 31 and 39 as well as Chinna, should be abandoned and have their capital cost struck off the accounts; that Ghata-Shamabad and Itawa and the Bunds mentioned in paragraph 32 should be accounted for separately from the other Bunds of the district, if the two former are to be maintained by recovering the cost of their repair by a bakh on the villages benefited, while the latter should be abandoned and their capital cost struck off in case the zemindars interested in them refuse to maintain them under special arrangements; that the ownership or control of the sites of all works should be secured by the Board; that the present figures of the capital cost of the Kotla Road and Chandel Cut should be revised and reduced, the capital cost of the Tauru-Jatanli Road being divided under the heads of Public Works and Irrigation; that the general standard of assessment for the benefit of Bund irrigation, both up-stream and down-stream, should be fixed at a uniform rate, say, Rs. 0 5-4 per kachela bigha (½ of an acre) on crops harvested and should be notified, with half rates on dahi lands and exemption for dahi, unless the dahi or dahi was purposely irrigated when it should pay full rates, the rates on the Chandel Cut being maintained at Rs. 0-2-1 and on the Gurgaon Training Works increased to Rs. 1 per kachela bigha on sugarcane and gardens; that special care be taken to ensure the proper working of the Bunds and the full assessment of all lands that ought to contribute to their upkeep; that the income from trees and grass be developed; and that expenditure, out of the general revenue of the Board and under control as ordered by Government, on the future development of the Bunds should chiefly take the direction of improvements, especially by the extension of rajbahs, of the Kotla Jhil system, the Gawalpahari-Jharsa system, and the Tauru-Jatanli Road, all of which are most valuable and are remunerative.

1. Q. (The President).—You are Judicial Secretary to the Punjab Government?—Yes.

2. Q. You were formerly Deputy Commissioner of Gurgaon?—Yes, in 1891-1895.

Witness explained to the Commission by a reference to maps several points in his note in connection with the Bund system.

3. Q. (The President).—There is a large area of irrigation in the district—143,000 acres?—That does not show absolutely the whole of the land irrigated by bunds; in years of good rainfall, there is a tremendous amount of irrigation. The average annual rainfall is, I think, about 29 inches. The area irrigated varies greatly with the rainfall. The average of the last few years is put down as 6,000 acres but this is probably an under-estimate. The bunds are no protection against famine; they are more for protection against floods.

4. Q. Is there any means of so arranging these bunds as to form tanks?—In one or two places, I think, you could form permanent lakes, but I imagine the value of the land is now too great.

5. Q. What is that value due to?—To the bunds.

6. Q. The land is in private hands?—Yes.

7. Q. The broad question we have before us is, what can be done to help to protect this district from famine. What relief could you give to the people, in parts which are not protected?—I don't think bunds are of any use in years of low rainfall; they allow of the best use being made of such water as there is and in years of good rainfall they are of extremely great value in protecting the depressions which would be water-logged.

8. Q. I see there is a good deal of well irrigation?—In the Rewari tahsil.

9. Q. What is about the depth of the spring level of the wells?—I don't know.

10. Q. Was much done in the way of takavi advances for increasing the number of wells?—Nothing exceptional was done while I was in Gurgaon; the usual number of applications only was received.

11. (Mr. Higham).—I do not quite understand this point as regards the cost of these bunds?—My point is that the whole question of these bunds was referred to Government and the Lieutenant-Governor was of opinion that the District Board should not spend their money upon them unless they made a reasonable return on the capital invested. I made enquiries and I was of opinion that the capital cost of the bunds as shown in the District registers submitted to

Government was excessive and I proved that the Bunds did return a fair rate of interest.

12. Q. You are merely depreciating the full book value being taken into account in estimating the profit?—I think the book value as put down is wrong.

13. Q. The question of first cost merely affects the estimate as to the profit that can be expected?—Yes.

14. Q. Is money lent to the Board for carrying on these bunds?—No, they find it out of their own income.

15. Q. The Provincial Government gives no assistance?—No, except that the Public Works Department gives occasional assistance in deputing an officer to find out a suitable site for a bund or for some other professional work.

16. Q. In the case of famine works a number of works are carried out by relief labour at the expense of the Local Government?—I don't know whether famine labour has been employed on these bunds.

17. Q. (Mr. Wilson).—You give an account of the financial results of the Kotla system. If bunds did not exist Government could not recover so much revenue as they do now, could they?—No.

18. Q. Would not much of the land revenue now realized have to be remitted if the bunds did not exist?—I don't think much remission would be necessary.

19. Q. Takes all that has been done in the last 30 years at the expense of the District Board and zemindars in improving this bund system, has not that largely increased the produce of the district?—Yes.

20. Q. Will this construction of embankments not lead to an enhancement of land revenue?—Yes.

21. Q. Which could not have been taken if the bunds had not been made?—No.

22. Q. So Government will derive considerable profits from the making of these bunds?—Yes.

23. Q. To which it has not contributed anything?—No.

24. Q. Is there much room for further extension of bunds of this description?—Improvements in bunds should take the direction of making channels for irrigation by rajbaha.

25. Q. If such improvements were made, would they not lead to an increase in the land revenue?—Yes, certainly.

26. Q. Should not Government in that case help in the construction of such improvements?—Yes, I think Government should help.

27. Q. Have these tracts been properly surveyed?—Yes.

28. Q. Is there sufficient help in the way of professional advice by Government departments?—We have a very good man—Mr. McGregor—the District Engineer, who is able to do what is necessary.

29. Q. You recommend that some bunds should be abandoned, have these led to any increase of Government revenue?—Yes.

30. Q. Should not Government help to pay something of the whole cost?—Yes, if Government land revenue is increased. I consider that the bunds should be kept in the hands of professional people—District Engineers—who could manage them.

31. Q. Under the control of the District Board?—Yes, practically that is the Deputy Commissioner.

32. Q. Do you think the present system of District Board management of the bunds works satisfactorily?—Yes, if the Deputy Commissioner takes an interest in the business, but if the Deputy Commissioner does not keep things tight affairs get bad.

33. Q. It is a great advantage to have a District Engineer who remains permanently and looks after them?—Yes, it is a great advantage.

34. Q. Is there any difficulty in obtaining funds for the proper maintenance of them in times of drought?—I have never heard of such difficulties; during the years I was here there were none.

35. Q. The income didn't fall off?—No.

36. Q. (Mr. Ibbetson).—How far can you say is Gurgaon protected against famine; it has a canal and it has a large number of wells in the Rewari and Palwal tahsils?—I think the Rewari and Palwal tahsils are fairly well protected.

37. Q. And the rest not?—Quite so.

38. Q. Is that half the district?—Yes.

39. Q. And the bund area lies in that half?—Yes.

40. Q. Why were these bunds so out of repair about the time of the settlement and after that?—Because the District officers took no interest in them.

41. Q. Were they then under private management?—In 1870 the bunds then existing were handed over to the District Board, having before that date been under the management of the North-Western Provinces Irrigation Department.

42. Q. Before that they had gone out of repair?—Yes.

43. Q. Why have they never been under the people's management?—The financial results, I expect, under the management of the North-Western Provinces Irrigation Department were unsatisfactory and the Canal officers, who were responsible for the management and lived in the bund area, were withdrawn to undertake other more profitable works. The continued maintenance, however, of the bunds was of importance, and as it was thought that management by the people would not secure this, the bunds were put in charge of the District Board and the Deputy Commissioner.

44. Q. I understand these bunds are mainly systems of bunds dependent on one another, they are not purely local works?—No.

45. Q. And therefore not adapted to local management?—No.

46. Q. When you say you would discourage bunds under private management, do you mean these bunds should not be under private management, or do you refer to their construction?—Bunds should be built by District authorities.

47. Q. Supposing the District authorities were not prepared to build— if they had not the money?—I think the management should be subject to the control of the District authority.

48. Q. Why should the management of a local bund affect the general scheme of the bunds?—I don't see how you can have private bunds in the middle of large schemes.

49. Q. Could not local bunds be constructed in Gurgaon?—They would not do much good.

50. Q. Outside your main systems of bunds, are there not places in Gurgaon where villages could help themselves by making local bunds and thereby provide themselves with a certain amount of irrigation?—Yes, there are.

51. Q. Would that be injurious in any way, would you discourage that?—I should like the villages to build such bunds, if the District Board could not supply the money. I imagine the District Board would be the better authority.

52. Q. There are places in Gurgaon where such works could be probably undertaken by the District Board?—Yes.

53. Q. Why were they not undertaken before?—Nobody took an interest in it till Mr. Macdonald came to the district. He worked the scheme and when I came to the district I did what I could to keep that going, but small bunds have not been taken up before because no Deputy Commissioner took an interest in them.

54. Q. Practical progress has been limited by the amount of time and attention each Deputy Commissioner was inclined or could afford to give to the work?—Yes.

55. Q. Is there any way of getting over the difficulty of stimulating the construction of these bunds?—The people would not find the money for large works and the District Board cannot find the money now owing to the famine.

56. Q. Supposing money was lent to the District Board?—That would be advisable.

57. Q. Supposing money could be given, would you prefer the District Board to the Irrigation Department?—Yes.

58. Q. Why? The District Engineer knows the place, and the Deputy Commissioner can settle any disputes among the people.

59. Q. Do you think the people would like it better?—Yes.

60. Q. Supposing at the next settlement it was possible to revise the existing assessment, supposing an improvement was made by which the irrigated area was extended and the income increased, would it not be fair to allow the District Board to take the additional revenue derived for a term of years, just as you allow the maker of a well to get the extra revenue that should be assessed for a term of years?—Yes.

61. Q. To return to wells, you say two tracts are fairly protected by wells?—Yes.

62. Q. Why is well irrigation not practised on the other tracts?—There are a number of wells in the south of the district; in the flood area wells could not be sunk.

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Mr. C. J. Hallifax. 63. Q. Do you think the number could not be gradually increased?—No.

8. Nov. 01. 64. Q. You think that in those parts of the district in which well irrigation is fairly possible, they are tolerably well provided with wells?—Yes.

65. Q. You don't think anything is necessary to stimulate well irrigation?—No.

66. Q. Do you think the period of exemption from wet assessment sufficiently liberal in the case of wells?—I have not gone into that question.

67. Q. Do you think the fear of wet assessment ever prevents a man from making a well?—No.

68. Q. Do you think the 6½ per cent. rate of interest ever prevents him from taking *takari*?—No.

69. Q. Do you think you could give them help by sending an expert with boring tools who would show them where to locate a well?—I imagine they would not like interference of any kind.

70. Q. Take the case of the Rowari *chak*; it is almost impossible to say if you are likely to come upon salt or sweet water?—I expect the zemindar would rather chance it; the thing would be entirely now; in the end perhaps it would help.

71. Q. Do you think some good might be done in this way?—Undoubtedly.

72. Q. Are wells made in the rocky parts of Gurgaon?—No, they are only made in the alluvial parts.

WITNESS 24, MR. A. J. W. KITCHIN, I.C.S., Deputy Commissioner, Muzaffargarh.

Memorandum by Witness on Inundation Canals in Montgomery, etc.

Mr. A. J. W. Kitchen. 1. I have been called upon to submit a note on certain subjects under the consideration of the Irrigation Commission on which I had an opportunity of acquiring some experience during the time I officiated as Deputy Commissioner of Montgomery. I went to Montgomery as Deputy Commissioner in November 1898 and left at the end of March 1901 on leave to England. I am now temporarily in charge of Muzaffargarh. These papers only reached me on the 17th instant, and I understand that my note has to be in print by the 27th instant, so that I have had no opportunity of drawing up a detailed memorandum. Further, I write at a distance from Montgomery and have not been able to consult any of the files and papers in the District office or in any way to refresh my memory as to facts or figures. The impossibility of in any way preparing materials and the shortness of the notice given me must be my excuse for the inadequacy of the present note. I hope to be able to visit Montgomery and collect some statistics and prepare statements before the date of my verbal evidence before the Commission.

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2. The subjects upon which I am called upon to write a note are—

(i) Inundation canals in Montgomery.

(ii) Construction of canals by District Boards.

(iii) Effect of perennial canals on well and rainfall cultivation.

As to the first subject, I understand that questions of mode of revenue assessment of canal-irrigated lands are outside the scope of the Commission's enquiries. Excluding these questions I have nothing to say on the first subject which I cannot treat of under one or other of the other two heads.

3. There are at present six inundation canals in the two Bari Taluqs, Montgomery and Gurga, controlled and managed by the District Board.

They are as follows:—

Deg.	Jherku.
Nikki.	Gharah-Gharakna.
Sukhrava-Wah.	Pindl Sheikh Musa.

Irrigation from the first two is confined to the Gurga Taluq, the Sukhrava-Wah irrigates in both taluqs, and the last three irrigate cult in the Montgomery Taluq. The Deg Canal is fed by the Deg Nalsh, the waters of which are held up by a needle weir. The weir constructed in 1855 cost Rs. 11,000, and the canal which was completed in 1888 cost Rs. 22,000. The total length is 22 miles, and it irrigates about 6,000 acres. The Nikki dates from Mughal times. It has been at various times aligned and improved. The total length is 2½ miles and irrigating capacity about 5,000 acres. The Sukhrava-Wah was originally a natural nalsh. The Sukhrava was cleared out and straightened in 1893 and 1894 by Mr. Gladstone and was in late years been a good deal improved, and now takes into the old Wah Canal, which had silted up. Its length is about 18 miles and irrigating capacity about 4,000 acres.

The Jherku and Gharah-Gharakna are purely village canals which were taken over by the District Board between

1897 and 1899 and owe no part of their construction to the District Board, though, as a matter of fact, considerable expenditure was necessary before the canals would flow. The irrigating capacity of the Jherku is about 1,000 acres and of the Gharah-Gharakna about 6,000 acres. The Pindl Sheikh Musa Canal is a small water-course which only flows in high floods and is of no importance at all. Thus, of all the canals under the control of the District Board, the Deg is the only one which was constructed entirely at the cost of the District Board.

4. Until 1899 there was no separate establishment to look after the canals. The ordinary engineering staff of the District Board who were altogether without irrigation experience managed the engineering work, while the distribution of water was in the hands of *daroghas* who had neither engineering knowledge nor practical experience. In 1896 an Overseer with the rank of Superintendent was lent by the Irrigation Department at a pay of Rs. 180 per mensem, and he is now in charge of both the engineering and working of the canals. While the former system had no advantages at all, the latter has led to great increase of establishment charges. The income from the canals seldom exceeds Rs. 10,000 per annum, while establishment charges for several years exceeded Rs. 3,500. The District Board was bankrupt and in debt during most of the time I was at Montgomery, the income, owing to scarcity, falling from about Rs. 60,000 to below Rs. 35,000. When it is considered how large a proportion of the expenditure of a District Board is on fixed charges and how few retrenchments can be made without the sanction of the Educational, Medical, Postal and other departments, the difficulty of properly working District Board canals in famine times may be faintly realised.

5. The great difficulty which District Board canals in Montgomery have had to face is the inadequacy of the water-rate charge. The water-rate is only eight annas per acre of matured crop. The crop measurements are done by District Patwaris in the ordinary course of crop inspection. Eight annas per acre is the old customary water-rate which prevailed all over the district at one time. Even now "annas kaus" is the ordinary term for water-rate throughout the district. The sanction for the levy of a water-rate by the District Board is an order of the Local Government allowing the levy of such a rate under the District Board's Act. The sanction given in 1894 for five years expired in 1899 and was renewed for a further period of two years. The difficulty which prevents the water-rate being raised is that when the Montgomery and Gurga Taluqs came under settlement in 1892-94, canal-irrigated lands were assessed at special wet rates on the express understanding that the District Board water-rate would continue to be eight annas per acre. The assessment of the Bari Taluqs has been revised once and again, but there would be legal difficulties in raising the water-rate till the settlement of the Bari Taluqs expires in 1901. No doubt water-rate should be raised to an average fully three times as high as the present rates and should be fully as high as on the Government Canals in the Sutlej Taluqs. The supply is not so regular nor the distribution so good as on the Sutlej Canals, but the supply is often more plentiful and the Bari water is more fertile than the Sutlej water. A difficulty might arise in the case of the Jherku and Gharah-Gharakna as water-rates at eight annas per acre are levied on those canals under express

agreement. If the people did not agree to the rates being raised, and they probably would not agree at first, these canals could be controlled on the express understanding that the expenditure did not exceed the income. The whole case is, I believe, under the consideration of Government as I submitted proposals that all the District Board canals except the Gharah-Gharakna should be taken over entirely by Government.

6. The history of the District Board canals in this district is not such as to inspire hopes that such management is ordinarily likely to prove successful. Some of the many difficulties which present themselves may be detailed:—

(i) The success of management must depend on the personality of the Deputy Commissioner; some Deputy Commissioners take an interest in irrigation matters and some do not, and as a consequence there is no continuity of plan and no continuity of supervision and of effort. Periods of enterprise and periods of neglect alternate throughout the history of these canals, and the improvements executed in the periods of enterprise do little more than repair the mischief done in the periods of neglect. All Deputy Commissioners are alike in having no engineering training and no knowledge other than empirical.

(ii) The works are too small to enable properly paid and trained establishment to be employed. Ordinary District Board employes are poorly paid and have no prospects of promotion or of pension. As a result, District Board employes are certainly more corrupt than employes in similar positions in Provincial canals. Even the best employes fall off in efficiency when not under professional supervision. District Engineers have ordinarily no irrigation experience and the alternative presents itself of either dismissing old employes on the ground of lack of irrigation experience or of engaging separate officials for irrigation work.

(iii) Not enough attention is paid to financial considerations, and expenditure is allowed to exceed income over a course of years, and as a consequence the whole district is made to contribute more than a proper share towards the prosperity of a part. Want of due consideration before beginning a work results in the District Board finding itself burdened and its resources drained by a canal which cannot be made profitable and which cannot be abandoned.

7. The connection of District Boards with canals and irrigation works may be of three kinds—

- Construction.
- Management.
- Encouragement.

By construction I mean that the whole canal is designed, surveyed and excavated at the expense of the District Board and worked under the management of the District Board. The only canal in the Montgomery District belonging to this class is the Deg Canal. That the Deg Canal has not been a financial success is due in the main to the inadequacy of water-rate levied and in the second place to the difficulty of supervision. The canal is situated in a corner of the district which is out of the main working season from the rest of the district by the Deg Nallah and the Bavi, which are almost impassable in flood. When the waters are out the canal can only be approached readily from the Lahore District. Although entirely constructed by the District Board the canal suffers from the fault, common to all District Board canals in this district, of being wrongly aligned. When the canal was made no proper survey of the lands commanded was made. Ordinarily care and expense in initial survey before final sanction of a projected canal is not thrown away, but as a general rule a District Board has not got the men, or if it has got the men, they have not got the leisure to carry out a proper survey. My experience is that such men cannot even be borrowed. A poor District Board may well hesitate even to survey a proposed canal alignment, as the expense is considerable and the District Board cannot afford to risk the chance of the expense being useless, as such an expense would be regarded if the projected canal should be found to hold but no hopes of being remunerative. In my opinion a District Board should only enter on the construction of canals after very mature deliberation, after a proper survey has been made and with very

strong grounds of belief that the work will either be financially profitable or nearly so. Some trifling financial loss might be faced, provided that it was more or less proportional to the share paid by the villages benefited to the total land revenue cess of the district. Care must be taken in working out projects to keep the estimated duty very low, as under amateur management there is sure to be great waste of water. Even with the above proviso I should not think the District Board justified in undertaking the project, unless from the location or character of the work it would clearly be not profitable to the Government to itself undertake the work. With regard to the water-rate levied I do not think the District Board would have any claim to share of the water advantage, land revenue or owner's rate still less to a share of the ordinary dry rate land revenue. The water-rate should represent the full value of the water to the cultivator, and if such rate fell much below the expense of working and interest on capital the work would not be remunerative. No doubt in practice occupier's rate and water advantage or owner's rate are not fixed independently one of the other and the water-rate, if below a working expenses rate, could, at resettlement if the circumstances admitted it, be increased up to such rate.

8. By District Board management I mean the management of works not constructed by the District Board. As above stated all the canals of the Montgomery District Board, except the Deg Canal, fall under this head. When a project of taking over an existing canal is under consideration, so strong a case for action need not be made out as in the case of projected construction. Ordinarily preliminary surveys would not be necessary. The time has passed that associations of villages are able to construct and control irrigation works without assistance. District Boards might take over such works on satisfactory proof that the cost of management will not exceed income. There would be no desire to make a project, but the District Board should retain power to levy a water-rate sufficient to cover expenses of silt clearance and annual repairs. In most cases, by the exercise of a little energy and tact, villagers can be got to construct extensions from which they will themselves benefit. The difficulty in Montgomery has been that a water-rate has been fixed which would barely cover expenses of ordinary management and silt clearance, while improvements and extensions of all kinds have been made, very useful of their kind, but unprofitable. Canals of this kind have proved even more expensive to the District Board than the Deg Canal.

9. By encouragement of irrigation works I mean grants-in-aid to projected and existing works, which are not constructed or managed by the District Board, although they may or may not be managed by Government officials. Works of this kind have proved far more profitable in Montgomery to the District Board than works of either of the former kinds. The Deg embankment across the tail of the Deg Nallah was made some 10 years ago by the villagers concerned under the guidance of the then District officer. The embankment had been designed by Mr. Gladstone. The embankment still stands and for some years was of great value, irrigating some 6,000 acres of crops. Though still useful it is no longer so useful as it was, but this is the fate of all works of this kind. New channels form and old channels silt up and the work ceases to meet existing conditions. During the last three years a good many irrigation works have been started mostly on the Sutlej. They varied in character from ordinary embankments for holding up spill water to rough canals. The largest of all—the Mamunka embankment—has distributing branches 20 miles in length and during 1900-01 irrigated 40,000 acres of matured crops. The actual value of the work done in excavation and embankment was about Rs. 45,000. There were several other works of various kinds costing about Rs. 10,000 and irrigating in 1900-01 about 20,000 acres. In 1899-1900 the irrigated area of the then existing works was about 10,000 acres. The management of these works was entirely in the hands of the Deputy Commissioner, whose decision was in all cases final. No paid establishment was employed except the inevitable Tuhell chaprasi, and the local managers were in every case appointed from among the irrigators. The District Board provided money for small expenses which the people themselves could hardly be expected to provide, the principal items being pay of chaprasis, rewards for good work, *sarhadis* on occasions of festivity, baskets, tools, etc. The total cost to the District Board did not exceed Rs. 1,000, as against a direct income from fines on absenteeism of about Rs. 200. As the land irrigated is mostly under fluctuating assessment, the increase in rates has

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reoperated the District Board expenditure several times over. Generally in controlling and regulating river spill irrigation a good deal can be done with a very little expenditure of money, simply by organising and directing. One of Diwan Sawan Mall's titles to fame is his success in controlling and distributing river spill and at present for more in this way is done in Behawalpur than in the adjoining British districts. Similarly there is a good field for energy in regulating hill stream irrigation in sub-montane tracts. In some districts villages are left to litigate and riot about their hill stream irrigation, although a little assistance from District Boards and a little guidance by Government officials might easily result in harmony of working and improvement in distribution.

10. At present there are no new minor canals in the district under consideration. There is room for such canals on both the Ravi and the Sutlej, but the circumstances of the district will be so profoundly affected by the excavation, if carried out, of the proposed Lower Bari Doab Canal that it would be unwise even to consider any other canal schemes until a definite decision has been reached as to the construction of the perennial canal. If the Lower Bari Doab be made, no new canal scheme should be considered until the district has had time to re-adjust itself to the new conditions.

11. *Effect of perennial canals on sailab and well cultivation.*—When the Chenab Canal was constructed it was designed to irrigate the Government waste lands of the Jhang District and of the Montgomery District north of the Ravi. It was not proposed to give water to old proprietary estates. As the canal extended down towards the old estates north of the Ravi the agricultural conditions of the Ravi estates and in a measure of the whole Montgomery District were subjected to a disturbance previously unknown. In Montgomery difficulty is always found in getting and keeping tenants and no landlord could keep his tenants working on wells while prospects of wealth and ease offered to them on the Chenab Canal. The disturbance was further intensified by failure of rain and river spill and resulted in a great part of the Ravi Tahsil going out of cultivation and whole villages being absolutely abandoned. It was found necessary to alter the revised settlement of the Ravi Tahsils and to allow purely fluctuating assessment to all riverain villages which asked for it. Similar difficulties have, I believe, been found in Jhang. I understand that the Punjab Government have now recognised the harm done to old agricultural estates by the extension of irrigation along their borders in Government waste, and orders have issued that Chenab Canal irrigation is to be extended, so far as may be possible, right down to

the north bank of the Ravi. Further in the Lower Bari Doab Canal project it has, I believe, been ordered that irrigation is to extend to the south bank of the Ravi. If both these proposals are carried out, the Ravi villages will have few legitimate causes of complaint left.

The proposed Lower Bari Doab Canal is regarded with vague fear all over the Sutlej Tahsils, Pakpattan and Dipalpur. These two tahsils are now largely dependent on the Lower Sutlej inundation canals—Khanwah and Upper and Lower Solag. On the one hand, the water of the Beas is to be dammed up for the new canal and a failing in supply to the inundation canals is feared and expected. On the other hand tenants will be attracted away to the easy and safe cultivation of the perennial canals. The Sutlej zemindars fear that the history of the Ravi will be repeated on the Sutlej. Everybody in the Montgomery District believes that the failure of floods in the Ravi is solely due to the head-works of the Bari Doab Canal. The Sutlej zemindar now expects that the Lower Bari Doab Canal will be to him what the Bari Doab and Chenab Canals have been to his neighbour on the Ravi. If, as I understand is the case, the Government have now realised that the anxiety of the Sutlej zemindars is not altogether unfounded and if the old villages are to be treated with consideration and sympathy in fixing irrigation limits and distributing land, the effect of the Lower Bari Doab colonisation on the old estates may be small. Regular sailab cultivation has nothing to fear from the attractions of canal irrigation, but well cultivation can hardly be carried on in competition with flow irrigation.

12. There is one private canal in the Montgomery District. It was constructed some 16 years ago by Mohan and Mehdi Khan, an Extra Assistant Commissioner, primarily in order to irrigate a grant of 6,000 acres which he received from Government. The cost of excavation was about Rs. 1,00,000 and the irrigated area is about 10,000 acres. The canal was aligned and made with considerable skill and has been very successful; water is given to the lands of villages commanded by the canal. The water-rates vary in every village and are generally very much higher than the rates on Government canals. The estate and the canal has been the subject of the litigation for nearly ten years. In 1904 the canal can under the conditions of the lease be taken over by Government without compensation. It is to be hoped that this will be done, as, apart from the quarrel among the lessees, the present management is exceedingly unpopular among the zemindars who take water. In my opinion it is not possible and still less is it desirable to encourage the construction of private canals.

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1. Q. (The President).—I understand you are Deputy Commissioner of Muzaffargarh?—I was; I have left it.

2. Q. Where are you now?—I am Assistant Settlement Officer at Dera Ismail Khan.

3. Q. You have been both in Montgomery and Muzaffargarh?—I was only 3 months in Muzaffargarh; I was 2½ years in Montgomery.

4. Q. You have had experience there of Inundation Canals?—Yes.

5. Q. Have you had any famine experiences?—No.

6. Q. Where does the Deg Canal come from?—It comes from a hill torrent through Sialkot.

7. Q. I suppose it runs dry in the dry weather?—Yes, generally it is very irregular.

8. Q. These canals are managed by the District Board?—Yes.

9. Q. By what agency were they constructed, to begin with?—The Deg Canal was made from the beginning by the District Board; the others were taken over.

10. Q. I gather from your note that you don't think the District Boards are a convenient machinery for working canals?—No.

11. Q. Will these canals be to some extent superseded by the Chenab Canal?—No, but perhaps by the Lower Bari Doab Canal; the Deg Canal cannot be affected, matter explained on map.

12. Q. How long do these Inundation Canals run?—They run up to the end of September: the Deg has been known to run all the year round.

13. Q. Do they start *rabi* cultivation with them?—Yes, the crops afterwards are as far as possible well irrigated, but

a large area has to trust to rains. There are not so many wells on the Ravi as on the Sutlej.

14. Q. You say the District Board Canal should be entirely taken over by Government, who would work them?—The Irrigation Department; my idea was that the Deg should be run by the Chenab Canal Officers and the others by the Upper Sutlej.

15. Q. How did these canals do in 1899-1900, in time of drought; I suppose floods were very low?—Last year we got 43,000 acres; that was exceptional; in the famine year the total was only 8,000 acres. During the last 20 years the District Board has lost 1½ lakhs by the canals; it had a fine hand and with proper management the canals should have paid.

16. Q. Is there much extension of well irrigation going on?—Not a very great deal; of course the greater part of the area of the Montgomery District is waste; lands are being given on leases, and new leases always provide for well-sinking; there are 66 villages which are Government villages, in these there are some conditions as to well sinking.

17. Q. Where are these villages?—Down towards the rivers.

18. Q. Are there enough wells to carry on the irrigation started by the inundation canals?—They are not sufficient. There is always a difficulty in increasing the number of wells; one well may have been sunk in such a place that others cannot be sunk in the same holding or the holding may be too small for a well.

19. Q. How deep is the water below the surface?—It varies very much indeed, from 25 feet near the rivers to 60 feet.

20. Q. There is evidence to show that there has lately been an increase of wells in the Punjab?—Yes, there has been an increase in the Montgomery district in the last 20 years. Wells are absolutely vital to inundation canal irrigation.

21. Q. Do you think that Government should do anything to increase the construction of wells. Is there any measure that Government could take in that direction?—I don't know of any.

22. Q. What about *takari* advances, do you think the rate of interest of 6½ per cent. is high?—It is not high, but I should like to see it much reduced. I know of one case where a man borrowed Rs. 800; he paid back Rs. 600 and still owes Rs. 100. That looks hard.

23. Q. We have heard evidence to the effect that in some cases the Deputy Commissioner had not time to attend to the matter of giving *takari* advances?—It is not only a question of time; most of the time I had the greatest difficulty in getting money for *takari*.

24. Q. If the Civil officer had the time to go through a number of cases and if there was a reduction of interest do you think *takari* would be taken in larger quantities?—No doubt all these things would tell; but I don't see how the Deputy Commissioner can stimulate the construction of wells. The people know when they want wells. I had the greatest difficulty in getting money for *takari* for wells owing to its being required for famine and seed. It would be a good thing if one could deputise one's powers to an Assistant; or in case of advances for seed to the Tahsildar. The rule by which every cheque has to be signed by the Deputy Commissioner complicates matters very much. Then again if I send the Tahsildar Rs. 5,000 and he only spends Rs. 3,000; the 2,000 are no longer available for *takari*, as under the present system Rs. 3,000 are entered as spent and Rs. 2,000 are recovered.

25. Q. Does any of advances stick on the way and never reach the cultivator?—No doubt he has to pay tips, but nothing like 20 to 30 per cent. as I have heard said; perhaps 5 or 6 per cent. on seed advances without interest.

26. Q. Would it be a popular move if Government gave *takari* for wells free of interest?—I don't think letting off interest would do much good. It would all help.

27. Q. (Mr. Wilson.)—If the District Board had expert advice, do you still think their management would be inefficient; is there anything in their management that is wanting in vigour?—The ordinary subordinate of the District Board does not work satisfactorily. I still think the management of the District Board is not sufficient; the Deputy Commissioner is not qualified to manage canals.

28. Q. You say, "in my opinion it is not possible and still less is it desirable to encourage the construction of private canals." Why are you so strongly against them?—I have come across two and can only speak of these: on these canals the management is exceedingly unpopular with the zamindars; there is no security that they will get water and the prices charged are sometimes enormous.

29. Q. (Mr. Wilson.)—You mention the difficulty that the District Board has in maintaining these canals in hard times?—The difficulty was to get money.

30. Q. You didn't ask Government for any advance?—We had permission to overdraw from time to time; Rs. 10,000 was overdrawn.

31. Q. Has Government charged any interest?—No.

32. Q. Was that not sufficient to maintain the canals properly?—Everything absolutely necessary was done; anything like improvements had to be postponed for want of money, the existing works were kept up.

33. Q. Is a water-rate paid to the District Board?—Yes.

34. Q. Is there any *chker* labour?—No.

35. Q. I believe nothing is credited to the District Board on account of the increase of land revenue?—Nothing whatever.

36. Q. In the case of the Imperial Inundation Canals, is there not a credit made to the canals on account of the share of land revenue; in Montgomery a canal advantage rate of 3½ is credited?—Yes, that is taken into account.

37. Q. Should not a similar credit be given to the District Board?—Yes, but the District Board would not want to make a profit.

38. Q. Is not a large part of the land revenue due to canals?—Yes.

39. Q. Should not canals get the credit for that?—Yes, certainly; I wanted the canals to get the whole of it. Mr. Donio recommended half and even that was not allowed; the question is, I believe, under the consideration of Government.

40. Q. You say in your note, "a District Board has not got the men, or if it has got the men, they have not got the leisure to carry out a survey." Has any proper survey been made yet?—No, a proper survey is very expensive.

41. Q. Are you not hampered by want of a proper survey?—Yes, very much; even the Deg Canal was wrongly aligned.

42. Q. A good deal of money has been wasted in that way?—Yes.

43. Q. Why has the District Board not had a proper survey made?—Their canal was made in a hurry 15 years ago.

44. Q. Why has not a survey been made in the last 15 years?—I don't think it would be much use doing it now; it would not pay the District Board to level these lands now.

45. Q. In the District Board in a position to have that done?—No, and I could not get men from the Irrigation Department.

46. Q. You have mentioned a large loss to Government on the Ravi lands owing principally to the construction of perennial canals?—Yes (figures read out from a memorandum).

47. Q. At all events there has been a great loss of land revenue in the Ravi Valley owing to the opening of the Chenab Canal. Do you think that should be charged to the Chenab Canal?—Yes; or half of it.

48. Q. Does it not mean a great loss of resources to the people themselves?—Undoubtedly.

49. Q. Should not Government do what it can to maintain these people in their old prosperity?—To a certain extent something was done and is being done. We gave them 10,000 acres for temporary cultivation on the Chenab Canal.

50. Q. As regards *takari* for wells, if a special officer went round with money and gave it free of interest to any landowner who could show that it would be an advantage to make a well; do you think that would lead to an increase in the number of wells?—Perhaps it would; of course there would be a lot of trouble afterwards in getting the wells made.

51. Q. Is there much trouble ordinarily in that direction?—Yes.

52. Q. At any rate the well is made?—Yes, it often happens that a well falls in before the amount is paid. In parts of Montgomery the sinking of wells is a lottery.

53. Q. Would it not save people a considerable waste of money if boring tools were supplied by Government to enable them to discover what the water was like and so on?—It might, if somebody was sent to do the boring.

54. Q. (Mr. Hipham.)—In 1901 you had 40,000 acres irrigated by canals?—Yes, and 60,000 acres irrigated by embankments.

55. Q. And in the previous year only 10,000?—Yes.

56. Q. Would these works ordinarily give you 40,000 to 60,000 acres?—They might.

57. Q. Is this area entirely due to embankments?—Yes.

58. Q. These embankments are made by the people?—Yes, entirely; an old branches of the river.

59. Q. Did they ask to make them?—No, they were told to.

60. Q. How do the District Boards come in?—The difficulty in such cases is cash payment of obstructions and so forth; the District Board found petty cash for sweetmeats, etc. The people all turned out and there was no difficulty. The District Board had nothing to do with the management.

61. Q. They don't have much to do with it?—No, not with the management.

Witness No. 26. Mr. E. DeCANE-SMITH, Sanitary Engineer to Government, Punjab.

Memorandum by Witness on Flood Protection and Drainage Works.

Under head No. 7 of the points to be considered by the Irrigation Commission I should like to offer some remarks. There are doubtless a number of places in the province

where flood protection or drainage works are required. These would be small works as a rule, but there is one tract to which I would specially draw attention where

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flood control, rather than flood protective works, on a very large scale could advantageously be investigated. I am alluding to the tract between the Sutlej and the Jumna where the torrents of the Siwaliks pour their floods into the plains, and in this tract it is the part lying nearest the Jumna in which I would more particularly refer. District and Settlement Officers have from time to time remarked on the large volumes of water that now are poured uncontrolled over the Ambala and Karnal districts, and there is hardly any one who knows anything and who has seen anything of this tract of country during and after the monsoon who has not wondered whether something cannot be done to control the floods that one year may bring prosperity, another year sickness and unlimited damage to the area affected. My acquaintance with the tract in question dates back to 1880, and between that year and 1884 I saw a good deal of it in many parts; not in the course of my work entirely, but when I was shooting. I saw parts of it again in 1889, and 1895-96 when in charge of the Ambala Provincial Division I saw a great deal more.

2. I am aware that something has already been done to utilise these floods by the digging of the Sarauti Canal, and that a project was made out by Rai Bahadur Genun Ram many years ago for one or two other canals. I know too that a large area of crops is matured on land saturated by ordinary floods, particularly in the Ambala district. But that an immense scope for extension of canal cultivation exists will be apparent from a mere citation of the area figures for one district only, viz., Karnal. Out of a total area of over 2 million acres, of which 1½ths are returned as cultivable, only 680,000 are actually cultivated. This, be it remembered, is a tract devoid of physical difficulties such as high rocky ground, sandhills, ravines, broken ground, etc., and with the water table only 30 to 50 feet below ground in most of the uncultivated area. The hill torrents that spill over the Karnal district are the Chittang, the Rakshi, the Sarauti, the Markandim Umla, and Tangil. The four latter work their way eventually into the Ghaggar, whilst the two former, even before they were taken in hand by the Irrigation Officers, had no well defined channels and got lost. The spill waters of the Rakshi and the Sarauti are practically the same, and in some years the whole country north of a line drawn through Pehowa, Thanesar, Indwa, and Jagadhri up to the North Western Railway may be said to be under water. If the floods could be run off quicker a large area could be cropped and matured by wells, but as it is the drainage that even in a year of heavy winter rains, like 1900-01, there are miles of country temporarily swamped I would strongly advocate that an attempt be made to get control of all these streams south of the North Western Railway. Very extensive surveys would be necessary over the whole area affected, which would be found to extend west of the Karnal district into the Patiala State, and at the same time as the topographical survey was in hand a Settlement or Revenue Officer should go round with the Engineer doing the survey. Working from the south upwards a system of drainage cuts and bunds could be worked out which by dams and regulators would permit of the control of floods, water being given to low lands for a proper time and surplus being passed on to the main natural outfall of the Ghaggar. There would be nothing specially technical in these drainage works which would necessitate the calling-in of Irrigation experts. They would be such as any Engineer working in concert with the District Revenue officials could design and manage. But the question of dealing with the floods in the Ghaggar is one I would leave to the Irrigation Officer, as it would be one requiring special knowledge. The Ghaggar flows in a channel quite 30 feet below level of the country even as far south as the tail of Ghaggar Branch of the Sirhind Canal, so water could not be brought to the surface and utilised, say, in the Hissar district, without dams and works of some magnitude, but that the floods could be controlled and utilised will, I think, be accepted. The question arises, would such a scheme as this pay? Without a detailed investigation I don't think any one would like to pronounce an opinion, but we have strong *prima facie* evidence on which to base a hope that it would pay. We have a large area now lying waste in

the Karnal district, and we know that water is eagerly desired in the precarious dry tracts of Hissar and Patiala. Indirectly there would be another benefit, in that the health of the people in the Ambala and Karnal districts would improve. It would take a strong survey party two years to get out the maps and make preliminary proposals, and the expense would be considerable, but the possibilities in the scheme would warrant it. It may not be out of place if I say that I have often talked this over with Colonel Jacob and he was always strongly in favour of making an investigation. He knew the country I write of well when Superintendent Engineer of the Western Jumna Canal, but he never had establishment to spare even to make the longest reconnaissance.

3. I mentioned that there must be many places in the province where drainage works on a small scale are required. These could be investigated and, if necessary, worked up on the initiative of the District Officer by the local Executive Engineer. As an example of the sort of minor work I mean I would instance the draining of the Mankerian, Tunda, Danyia Jhils in the Hoshiarpur, Jullundur districts. Speaking from memory, an area of about 4,000 acres could be rendered safe from excessive flooding there if the natural outfall from the Jhils, the nullah known as the West Beyn, were improved. The flooded lands in a wet year with high floods in the Beas are extensive, and crops can only be matured on the outskirts of the Jhils. In a dry year, such as 1899-1900, ½ths of the flooded area bears excellent crops. With efficient flood control the crops could be secured. Something might also be done in the East Beyn to turn its floods, if under control, over a dry area towards the south of the Jullundur Doab. There are many projects of the humble sort which might be profitably worked up by the Executive Engineer of the Provincial Division, if he had a charge of a lesser area and could find time to tour more with the Deputy Commissioner of the districts he is surveying in.

4. There is another class of drainage work that should not be lost sight of, and that is the improvement of Dhaks, ponds and low-lying ground outside important towns. This would be work done purely for sanitary purposes, but projects should be drawn out complete, so that in times of famine the poor and those thrown out of work could be given something to turn their hand to. There is always a floating population of the very destitute who flock to the large towns in time of scarcity, and it seems to me to be very desirable to have work ready to give them. In the neighbourhood of Amritsar, for instance, I could suggest drainage works on a large scale which, though not in the least remunerative, are undoubtedly both necessary and beneficial from the sanitary point of view.

5. In conclusion, though I shall be travelling outside my own sphere of work, I would like to suggest the investigation of a project for tapping the Jumna between Jagadhri and Laknauli to run a monsoon supply channel which would join the Western Jumna Canal at Munak. Thence following the Hunsi Branch, the channel could be taken down, the line of the Bhiwani Rajbaha and carried into Hissar, Joharn, Naraul, etc. Amongst suggestions I made in 1899, when starting the famine works in Hissar, was that some special channels should be dug from the Hunsi Branch to fill the large village ponds in that area just after the rain waterings were over. Colonel Jacob with whom I discussed the matter said that it would not be possible owing to the small supplies available in the Branch. He thought the idea a good one, but said unless we could feed the Western Jumna Canal by new supply channel from the river, it could not be done. If a new channel were a dug and a weir put across the river it would probably give the dry area of the Southern Punjab an assured kharif, but even if the monsoon were short and the river supply fell off early we might count on filtering the village ponds before June and getting a supply of "charri" for the cattle. A weir, I know would be a costly undertaking, 50 or 60 lakhs perhaps, but even in the cold weather it would give a small supply which would save the supply in the Western Jumna Canal, or, if it was found that the intermediate weir affected the supply at Okla, then the Agra Canal could be fed via the Delhi Branch with less loss of water than there is now in the wide sandy bed of the river.

1. Q. (The President).—You are Sanitary Engineer to the Punjab Government?—Yes.

2. Q. How long have you held that post?—One year.

3. Q.—Before that were you in the Irrigation Department?—Yes, I was for 10 years in the Irrigation Department.

4. Q. Have you had any famine experience?—No, none of actual famine. I devised and planned most of the works that were carried out in Hissar; the original programme consisted almost entirely of roads; then I suggested the making of large tanks.

5. Q. You have an intimate knowledge of the country between the Jumna and Sutlej?—Yes, I have served there and been over it often.

6. Q. This country apparently wants both water for irrigation and also drainage?—Yes, it wants drainage most.

7. Q. These drainage works you say there is no special difficulty about?—No, I don't think so.

8. Q. When you were in that country were you engaged on the Ghaggar works?—The central part of the country I knew when I was on the Sirhind Canal.

9. Q. What do you feel about that country; do you consider it is protected from famine?—I look upon it as a country that might produce good crops.

10. Q. There has been no famine there lately?—No, but I consider there were strong reasons for opening famine works in Karnal. With flood control works there should be no necessity of opening famine works for the cultivated area would be larger.

11. Q. There is an important suggestion at the end of your paper as regards tapping the Jumna; have you over-looked the levels?—No, I know it is perfectly feasible as far as mere levels go.

12. Q. (Mr. Higham).—Why do you say there is strong *prima facie* evidence that colonization of the tract flooded by the nalas in Karnal would pay?—Because of the scanty area of cultivation at the present moment.

13. Q. How would you increase that area?—The draining of the tract would make it more healthy and people would go to it.

14. Q. How do you propose to get water?—Control the floods.

15. Q. There is a great deal of cultivation caused by spill from the nalas; if you take away that what will happen?—You will have to hold it up by regulators.

16. Q. When you have a small rainfall the upper country will get the benefit of the regulator?—I don't think you ever get such a rainfall that you will have no floods; they may be late.

17. Q. Where is the revenue to come in from?—I suppose it would pay if the land was broken up.

18. Q. I have known this tract for the last fifteen years; there is strong *prima facie* evidence that you won't get

a penny from it; what is the evidence you rely on that it will pay?—The fact that the land is now lying as jungle.

19. Q. You have no crops there?—Very few indeed.

20. Q. About taking water from the Jumna into the Hissar district, have you ever gone into that?—I took out levels from some irrigation branch records and some plans in the office of the Executive Engineer, Umballa Division, with Colonel Jacob some years ago.

21. Q. Have you considered the duration of the high levels in the Jumna?—No, I have only seen the gauge diagram in the revenue returns.

22. Q. What do they say?—It says that by the middle of June there is a supply.

23. Q. Do they make any arrangements for filling the tanks that were dug in Hissar from the Western Jumna Canal?—There is no water available.

24. Q. But there is water available at certain times of year?—My whole proposal for a monsoon feeder from the Jumna came from that discussion with Colonel Jacob; he said there never would be enough water in the canal to fill the tanks.

25. Q. How much water do the tanks require?—It was the filling of the village ponds more than the tanks; the villages have no drinking water and so I suggested we should supplement the famine programme by digging channels from the Hansi Branch of the Western Jumna Canal.

26. Q. How long?—Some 25 miles long.

27. Q. What are the contents of the tanks?—1,000 feet long x 600 feet wide, and with an average depth of 12 feet.

28. Q. Is there any harm in doing that as a famine work?—There might be difficulty about water.

29. Q. At certain times of the year, when they close the Western Jumna Canal, you might pass the water?—Yes.

30. Q. It has not been proposed to make these channels?—No, the idea dropped because I was told it would be practically impossible to find water.

31. Q. Do you know anything about the railway tanks?—They are all puddled artificially.

32. Q. I am speaking more of those on the Rewari-Ferozepore line?—I think they are all puddled; at Bhawani we had two tanks; and the Irrigation Department said we must puddle them.

33. Q. Have they filled these tanks at Bhawani?—No, the expense of puddling was too great.

34. Q. Have you tried to let water in without puddling?—No, there is pure sand at the bottom.

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WITNESS No. 26—MALIK MUHAMMAD UMAR HYAT KHAN, TIWANA, owner of private canals in the Shahpur District, *Muht. Umar Hyat Khan.*

Memo. by Witness on private Irrigation Works other than wells in the Shahpur District.

Question I.—Is there any likelihood of the increase or decrease in the number of private canals in districts where they exist?—I, being a resident of Shahpur district, know only of the private canals of this district; I cannot say about the canals of the other districts. If there be no prohibition on the part of the Government, there is always hope of the development of private canals, either by the construction of new canals or the improvement of old ones.

Question II.—Have many new canals or has any been constructed within the past ten years?—No new canal has been constructed within the last ten years. There are following causes which have discouraged the owners and other persons from making any advancement towards the construction of canals:—

I.—Orders of the Government prohibiting the construction of new canals.

II.—Introduction of the new Bill for the management of canals, containing most strict rules against which representations have been sent by the owners for the consideration of the Government.

III.—The imposition, at the new settlement of two new cesses—the water advantage rates and the royalty rates—for the irrigated areas.

IV.—The expression of intention by Government to purchase the private canals.

V.—The apprehension that at the time of both harvests *khazif* and *rabi*, the water of the Jhelum Canals

will not be sufficient for the requirement of sowings, causing great disappointment and loss to the cultivators. Their representations regarding this are under the consideration of Government.

VI.—The separation of boundaries of private canals from Government canals.

VII.—The non-application of the provisions of Land Acquisition Act to private canals.

VIII.—The passing of the Land Alienation Act, which prohibits the acquisition of land for a new canal or a part of a canal.

Question III.—Have these canals been constructed by particular zamindars for the benefits of their tenants or by bodies of zamindars or tenants?—Canals of Shahpur district are of the following description:—

- (1) Belonging to a single owner,
- (2) Owned jointly by real brothers,
- (3) Owned jointly by near relatives,
- (4) Owned jointly by respectable zamindars,
- (5) Constructed by a body of ordinary zamindars.

No canal has been constructed in this district by any body of tenants, but nearly every canal has been made for the general use of all the tenants, whether they be cultivating under the owners of the canals or under other proprietors.

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Question IV.—Is the water supplied to the non-proprietors of canals, and on what rates?—From every canal water is given to other zamindars on payment of one-fourth of the produce as water rate. Zamindars and tenants find the following advantages in taking water from the private canals, which they cannot get from the Government canals:—

- (1) They only pay in kind whether the corn be selling dear or cheap and thus are saved from many difficulties.
- (2) In times of failures of crops and heavenly calamities they have only to pay the usual share of the actual outturn.
- (3) They can very easily irrigate their pasture lands for the grazing of their holkooks.
- (4) Poor zamindars and cultivators are given grain, seeds, and cash without interest as advances, which is gradually collected by easy instalments.

Question V.—Is it possible or advisable to encourage the improvement of canal works, and by what method?—It is most desirable and practicable to encourage such works. Long ago when nobody took any interest in the matter the Government persuaded respectable wealthy zamindars to construct canals, who made them at enormous expenses. These works proved very successful and tended to make culturable a large area of land which produced no income. Land revenue was greatly increased and zamindars became prosperous. If the Government will take into favourable

consideration the following points and concessions, it is certain that canal works will improve, and the zamindars will be taught a lesson of self-help, which is the chief aim of Government:—

- (1) There should be a free permission from Government for the construction of new canals or the improvements of old ones.
- (2) The new canal bill should be amended with regard to the representations submitted.
- (3) It is feared that the water of the river will decrease at the time of both harvests. At such times water should be supplied from the Government canals free to the irrigated lands and on payment of usual rates to unirrigated lands.
- (4) The Land Acquisition Act should provide for the acquisition of land for private canals, as they are also for the public benefit.
- (5) The Land Alienation Act should be so amended as to provide for the purchase of land on market price for the construction of a new canal or the improvement of an old canal. The restriction about tribe should be relaxed in these purchases.

If these proposals are taken into favourable consideration by the Government, the owners of the canals will be encouraged to make improvements, which will be the cause of public welfare and prosperity.

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1. Q. (The President.)—You are the owner of private canals in Shahpur?—Yes.

2. Q. How many canals have you got there?—Four.

3. Q. How much irrigation is done?—I cannot say exactly.

4. Q. About how much?—There are 24,000 bighas of my own, besides that I give water to the zamindars.

5. Q. You say, "the orders of Government prohibiting the construction of new canals are one of the causes which have discouraged construction of new canals?"—Yes, we could not make a new canal of our own accord or enlarge it: it would require the previous consent of Government.

6. Q. Was the consent of Government refused?—It was not asked for.

7. Q. You have never known consent to be refused?—No.

8. Q. Did you make these canals yourself?—No, my father did.

9. Q. Did he employ a surveyor to lay them out, or did he do it himself?—They didn't know much about levels consequently they didn't work properly, but by chance in the case of these canals they did extremely well, though in the case of others there were mistakes.

10. Q. How long ago was that?—It was in 1659.

11. Q. You give water to zamindars on payment: do you find that they are glad to take it?—Yes, they have to pay in kind; we take 1/4th of the produce for the water; the people are glad to get it on these terms. It is also to my interest to give ample irrigation; if there is not a good harvest we lose. We give water free to pasture lands.

12. Q. You have told us of the places where the system works well: supposing you were not inclined to take pains how would matters go?—Things would be bad unless the canals are dug properly.

13. Q. Is there well irrigation in your country?—Yes.

14. Q. Are there a great number of wells?—Yes.

15. Q. Have you got *pakka* heads for the canals? Yes three have got *pakka* heads and one has not.

16. Q. Have you constructed a number of wells?—There have been very few made in my time.

17. Q. How deep is the water below the surface?—Five yards; the water-level is rising and it is getting too damp for indigo and cotton.

18. Q. Do the zamindars who take water from you build *pakka* wells too?—Yes, to mature their *rabi*.

19. Q. What does a well cost there?—It used to cost Rs. 300.

20. Q. Many zamindars cannot afford to pay for wells; do they take *takavi* advances?—Not much; sometimes they borrow from the *bania* and pay interest.

21. Q. Which is the most popular?—If they have money they prefer to do it themselves; they seldom go to *banias*.

22. Q. Do they prefer to go to Government?—In that part of the country they don't give much *takari*; the funds received for *takari* are given to the Thal.

23. Q. Would they take money if they could get it?—Yes.

24. Q. Have you got any land upon the Jhelam Canal?—Only that land on which there is one of my own canals; there is a deed that if the Jhelam Canal came there I would have to relinquish a certain amount of land for the Jhelam Canal.

25. Q. I suppose that will improve your position?—Yes, in the place which was not irrigated before.

26. Q. On any of your other private canals would they get water from the Jhelam Canal?—Yes, they could if I applied, but the difficulty is that the canal is on the other side of a platform or saddle.

27. Q. With regard to what you say in your note, do you think power should be given to buy up land compulsorily?—Yes, otherwise they cannot take the head of the canal to the river, and unless they do so they cannot get water.

28. Q. (Mr. Higham.)—Have you *pakka* outlets on your canals?—Yes, on some.

29. Q. The zamindars make cuts in the banks?—No, only in the water-courses.

30. Q. (Mr. Ibbetson.)—These canals have been a very profitable business on the whole?—Yes.

31. Q. There are other rich people in the Shahpur district; are there not?—Yes.

32. Q. Why are there not more canals made like yours?—Most of the big owners have got canals.

33. Q. With regard to what you say as to the royalty rate, is it ever imposed?—Yes.

34. Q. How much is it?—Four annas an acre.

35. Q. When a man makes a canal at his own expense, is he not let off these rates for so many years?—I don't know.

36. Q. Suppose a guarantee were given that he would be exempted for 20 years would that not be an inducement to him?—Yes, no doubt: the crops are best in the first 20 years.

37. Q. You say, "one of the advantages of a private canal is that poor zamindars and cultivators are given grain seeds and cash without interest as advances, which is gradually collected by easy instalments." Have you much out in that way?—Yes.

38. Q. You recover in kind?—Yes.

39. Q. Do your tenants too?—Yes.

40. Q. With a generous and kind landlord that works admirably; but is there not fear that greedy landlords would use this as a means of getting the people into their debt?—I have not known it done in Shahpar.

41. Q. (Mr. Wilson).—You are in favour of extending private canals?—Yes.

42. Q. Do you know of any tract in Shahpar where you would like permission to make a canal?—There is no large tract left; there are only small tracts left for extension.

Muht.
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Hyat Khan.
8 Nov. 01.

WITNESS NO. 27—RAI BAHADUR MATA DAS, Extra Assistant Commissioner, Ferozpur.

I.—Memo. by Witness on Inundation Canals in the Ferozpur District.

In submitting the accompanying statement showing the progress made by the 18 inundation canals of the Ferozpur district, I beg to annex herewith three statements that "show at a glance the progress made by these canals" from the very beginning, and to make the following remarks.

They only "defect" under the present system (in regard to the records of the irrigated acreage only) is fully discussed in my recent report (herewith) sent up through the proper channel to the Financial Commissioner for sanction, viz., the appointment of separate Canal Patwaris—extract herewith.

I beg to say that the most important improvement has already been reported on over two years ago in regard to a new canal* suggested by Mr. C. M. King, C.S. the then Deputy Commissioner, and had it been sanctioned as was recommended by that officer there would have been no suffering and no complaint from nearly 33 villages of the Moga and Zira tahsils. The papers have been made over to the Department of Sirhind Canal who are again going into the question in full detail. Probably they will now be laid before the

* The suggested name is 'Kingswah'. The head of the canal would be in Ludhiana District.

T. MILLAR,
Deputy Commissioner,
22-10-01.

I am not aware there was any suffering. The people were anxious to get the canal last year, but there was no other complaint.

T. MILLAR,
Deputy Commissioner,
22-10-01.

Commission.

Before I can suggest any other "improvement" of Improvement No. II, greater importance on these canals, I must bring to the notice of the

Irrigation Commission the following facts:—

2. It has been decided by Government that a permanent weir or masonry wall will soon be constructed right across the River Sutlej not far from the junction where the two rivers, i.e., Sutlej and Beas, meet. The object is to take a new large canal from this point to irrigate the large waste area in Montgomery and perhaps other districts further down. Now 8 out of the 13 inundation canals take off from the the river below the proposed weir, and all lands commanded by these canals (over 15,000 acres) must suffer very considerably, for whereas now these canals generally irrigate from May to September, and thus not only the kharif crop is matured, but in many cases enough water is supplied for the cultivation of the rabi, which too is matured if there is even ordinary rainfall in winter or with the help of the wells. But after the proposed weir is finished, the 8 canals below that point will only run in time of very high floods, i.e., in July and August, when ordinarily we have the usual rain, and therefore the canal irrigation during the months of July and August only will be scarcely of any use, and it will hardly pay to keep up the establishment on the 8 canals and yet it would be a great pity to abandon them, because not only they have cost many lakhs of rupees, but that the people of Ferozpur, Muktear, and Fazilka tahsils will suffer very much indeed, to say nothing of the Mamdot Estate, which with a gross income of 3 lakhs per annum depends almost entirely on its own canals which are included among the 8 canals above alluded to.

T. MILLAR,
Deputy Commissioner,
22-10-01.

whereas now these canals generally irrigate from May to September, and thus not only the kharif crop is matured, but in many cases enough water is supplied for the cultivation of the rabi, which too is matured if there is even ordinary rainfall in winter or with the help of the wells. But after the proposed weir is finished, the 8 canals below that point will only run in time of very high floods, i.e., in July and August, when ordinarily we have the usual rain, and therefore the canal irrigation during the months of July and August only will be scarcely of any use, and it will hardly pay to keep up the establishment on the 8 canals and yet it would be a great pity to abandon them, because not only they have cost many lakhs of rupees, but that the people of Ferozpur, Muktear, and Fazilka tahsils will suffer very much indeed, to say nothing of the Mamdot Estate, which with a gross income of 3 lakhs per annum depends almost entirely on its own canals which are included among the 8 canals above alluded to.

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July and August, when ordinarily we have the usual rain, and therefore the canal irrigation during the months of July and August only will be scarcely of any use, and it will hardly pay to keep up the establishment on the 8 canals and yet it would be a great pity to abandon them, because not only they have cost many lakhs of rupees, but that the people of Ferozpur, Muktear, and Fazilka tahsils will suffer very much indeed, to say nothing of the Mamdot Estate, which with a gross income of 3 lakhs per annum depends almost entirely on its own canals which are included among the 8 canals above alluded to.

Now as to the "improvements" as regards these 8 canals, I beg to say that to avoid the above disastrous result of the proposed weir the only remedy is to make a feeder channel be made by Government above the proposed weir to feed all the canals below the weir, with such remodelling, etc., as may be necessary in order to feed the other canals below the junction.

But this is a big undertaking and a regular engineering establishment will be required. Hitherto we have managed to go on by following the simple but useful system established by Colonel Grey, the founder of all these canals, but the above improvement cannot possibly be taken in hand without engineering aid.

The Ferozpur Canal Fund might contribute say Rs. 30,000 to Rs. 50,000 towards the remodelling as suggested above, but in my humble opinion this will scarcely suffice to meet even half the demand. Anyhow, even if no Government aid is anticipated, it is quite worth while to do what is very rich and can well afford to pay 2 or 3 lakhs towards the cost of remodelling, and it would pay the estate immensely in the long run.

T. MILLAR,
Deputy Commissioner,
22-10-01.
We can save these canals and the Mamdot Estate, which is very rich and can well afford to pay 2 or 3 lakhs towards the cost of remodelling, and it would pay the estate immensely in the long run.

I may here add that Government charge a royalty or water-advantage rate of 6 annas to 12 annas per ghumaon on all the irrigated acreage and approximately get within one lakh of rupees annually without having paid anything towards the initial cost of these canals, and unless something is done to save the ready made 8 of these useful canals it will be a great hardship for the people of three tahsils of this district.

I may here add that the people who made these canals at their own cost under the sanction of Government and the guidance of their officer and have hitherto enjoyed the privilege of taking water have certainly some right to ask for the above favour at the hands of Government.

Finally, I am confident that should Government agree to utilize the surplus money of the Mamdot Estate in remodelling these canals the said estate will lose nothing; on the contrary, it will be a great gain to Mamdot itself, inasmuch as not only its own four canals will be saved, but that the money lent for the benefit of the other canals (that is the property of the *abnashes* of this district) will be easily recovered with a small interest, say 5 per cent., in the same way as was the case when in 1897 the District Board had lent over Rs. 46,000 for the widening and extension of the Aghawali, the great success of which scheme now speaks for itself. The District Board had, however, charged no interest, and Mamdot might or might not do so. Anyhow this is a matter of small detail.

It has been suggested by the Engineering Department, I am told, that the people of the Ferozpur Inundation Canals have only to deepen them and take the water-supply further down, where it will irrigate (now) land. To this I beg to reply that apart from the great drawback, as explained in Paragraph 2, page 1 of this note. The mere deepening of the existing canal beds will most certainly deprive a considerably large area of its usual water-supply for the first 20 miles approximately. Moreover, all these canals are confined to the Ferozpur district, where the people gave their land free of charge for mutual good, and if, as suggested above, we were to deepen the canals, we may have to go beyond this district further down in order to utilize the supply produced by a much lower proposed bed of the canal, which arrangement is neither profitable to the people of this district nor practicable from our point of view.

Statement of progress on the 13 Inundation Canals of Ferozpur District abstracted from three statements which accompanied witness' memo.

	Rs.
Cost of original work, 1874-1901	9,33,249
Cost of silt clearance and establishment	15,88,765
Total expenditure	25,22,014

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Bahadur
Maya Das.

Statement of progress on the 13 Inundation Canals of Ferozepore District abstracted from three statements which accompanied witness' memo.—contd.

8 Nov. 01.		Total area irrigated 1875 to 1901	Acres.
	Area irrigated 1891-92	.	2,636,402
	" " 1892-93	.	121,397
	" " 1893-94	.	168,056
	" " 1894-95	.	138,049
	" " 1895-96	.	128,557
	" " 1896-97	.	56,107
	" " 1897-98	.	84,537
	" " 1898-99	.	162,944
	" " 1899-00	.	151,247
	" " 1900-01	.	138,562
			260,351

II.—Extract from a Report by Rai Bahadur Maya Das, Extra Assistant Commissioner, in charge Inundation Canals, Ferozpur, to the Deputy Commissioner, Ferozepore, dated the 2nd August 1901.

With reference to Commissioner's No. 2626, dated 13th July 1901, I beg to report as follows:—

2. Under the present system the Revenue Patwari is required to perform the following duties in connection with the area irrigated by the 13 inundation canals of the Ferozepore district:—

Firstly, as soon as the *khurif girdawari* is finished (October and November) the Patwari is to submit at once through the Tahsildar the "*fard tanazah*" (list of the irrigated area in dispute) to the Extra Assistant Commissioner in charge of irrigation.

Secondly, simultaneously with the above the Patwari is to distribute to the *abnooshes* concerned their *parchas* of the area irrigated. This is necessary because it is but fair to the irrigator that he should know there and then (if the Patwari has recorded any area as irrigated), and be allowed every opportunity to raise any objections he may have thereto; and if the Patwari gives him the *parcha* the irrigator can, if he really has a grievance, at once go to the Superintendent of Irrigation, who forthwith starts an enquiry to be made on spot.

Thirdly, to prepare separate *khataunis* for each village of the area irrigated, and submit to the Extra Assistant Commissioner in charge by the 15th of November.

Fourthly, when the *rabi girdawari* is finished (end of March) the Patwari is to submit a *fard* or list of all such areas as were recorded *taraddadi nahri* during the *khurif girdawari* (in October and November) when the canal water in some places is not quite dried up, but it is expected that eventually the zemindar as usual will bring it under cultivation later on and yet for some reason or other it has remained *khali* (without any cultivation) in both harvests, and all canal charges on such area of course to be remitted after it has been ascertained by local enquiry that the Patwari's records in this respect are correct.

3. Now as to the first duty of the Patwari, hardly and *fard tanazah* are received in November; but most of them come in January and February, and several Patwaris wait until March and April. The result is that, while the cases of area in dispute ought to be disposed of before the 15th December (*vide* Rule XI), they linger on until the month of May and sometime even later still. Moreover, the Patwaris not only send their *fard* late, but send them so irregularly that often the Canal Tahsildar has to go to the same village two or three times over again, when (in May and June) he is also waited elsewhere in checking the accounts of the Canal Darogah in connection with the earthworks of silt clearance and other repairs approaching completion. Another great hindship to the *abnoosh* (irrigator) concerned is that the *fard tanazah* is submitted very late by the Patwari the disputes as to the irrigated acreage must necessarily be disposed of too late to allow the *abnoosh* concerned the due credit for the area remitted during the same year, and the result is that the irrigator has

to wait until the next season, and as it often happens that many *abnoosh* and land-holders submit annually their land on certain terms, one of which is that the *assami* or tenant is to pay the canal charges, and it is as likely as not that another "*assami*" may take the land in question for the next year and thus the man who ought to have been credited with the remission suffers this loss for no fault of his, because unless the land owner gets credit for his remission in time, he is not likely to repay to his former *assami* who has left the land.

4. In regard to the second duty of the Patwari, it is noteworthy that the *parchas* of the area in dispute that should be distributed to the *abnoosh* concerned before the 15th November are not given to the latter until March and April and even later; the ignorant zemindar who is at the mercy of the Patwari dare not complain too loudly, although I have frequently made enquiries at the request of several zemindars why the *parcha* was not given to him, but the result of this enquiry invariably is that the Patwari comes off more often victorious than the zemindar. Moreover, when the Patwari for reasons of his own does not inform the zemindar concerned which of his land he (the Patwari) has recorded as irrigated (very few, if any, of the zemindars accompany the Patwari when the latter is doing his "*girdawari*") the *abnoosh* having received no *parcha* from the Patwari believes that all is well as regards his land, until all of a sudden when some months after the records are completed and canal charge is allotted and new irrigation has begun (in June) the Tahsildar demands the canal dues for the past season. Then the eyes of the irrigator are opened, but opened too late. The crops are cut and removed and new irrigation is then going on, and it is almost impossible to dispose of the case correctly even by local enquiry.

5. Again, the Revenue Patwari often omits to date the *parcha* or antedates it in order to protect himself from the accusation of having given the *parcha* too late. Moreover, in several cases it has noticed that the Patwari has recorded the area irrigated by one person in quite another man's name (and the *parcha* is purposely given to late in order to make the enquiry hopeless), and the wrong man who has been charged with canal dues for nothing finds it very hard to extricate himself from the Patwari's net so cunningly spread. The Canal authorities can only investigate the case of area in dispute thoroughly when the *parcha* is given in time and the party concerned applies in due course.

6. With regard to the third duty of the Patwari, I beg to say that, while the canal *khataunis* are due by 15th November it only commences to come in in January and are leisurely submitted until the end of March, often in April. But this year the Patwaris have exhausted my patience by sending some of their *khataunis* as late as May and June and a few have even surpassed all previous records of delay (in spite of constant reminders to the Tahsildars and frequent complaints made by me to the Deputy Commissioner) by submitting their *khataunis* of the past year now in July when the new irrigation is in full swing, and I believe two *khataunis* of the Ferozepore tahsil are still wanting. The most serious trouble that is caused by this extraordinary delay is that we cannot make a correct estimate of the quantity of silt clearance that the *abnoosh* concerned has to perform according to the area irrigated by him during the past season, and this estimate or budget called *dak bandi* has to be prepared in January in order to enable the Canal Department to start the earthworks in time; and unless we do so, we cannot possibly

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open the canal in due season. The result is that our approximation of the irrigated acreage each *abnosh* is (in cases in which the *khataunis* have come much too late) formed more or less on a wrong data.

7. Moreover, the too late *khataunis* is also responsible for starting the work of silt clearance too late (April or even May) when the *zamindar* is too busy with his crops, and not only he is not then available to do his quota of silt clearance, but hired labour is then very scarce, as the *zamindar* pays in kind for cutting crops when an able-bodied man can often earn 12 annas per diem and he will naturally not care to go to the canal works to earn less than half of that amount: we are therefore, often obliged to raise the rates reluctantly at the end of season, to finish the silt clearance before it is too late, and all this means higher charges for silt clearance that has to be paid by the *abnosh*. This submission of *khataunis* by the *Patwari* so late as described above tells on all concerned, yet there is another (serious) difficulty in starting the earthworks late. Most of the heaviest silt clearance is near the head of the canal where it takes off from the river, and during the month of April and May when we are trying hard to finish off the digging near the canal head close to the river the water springs up in the canal bed by percolation, and it is often 2 to 1 foot deep and at times it is so difficult (almost impossible) to clear the silt under water that we are compelled to leave it alone, which means a loss in the discharge, and, therefore, less irrigated acreage. Having explained some of the serious difficulties we have to contend with in dealing with the Revenue *Patwari*, I must add in fairness to him that his own revenue work is good deal heavy, and he naturally considers (like some of the *Tahsildars*) that the canal *parchas* are not of much consequence, and that they may wait, and when at the nick of time there is a hue and cry for the *khataunis*, the *furd tanazzah*, and the *parchas*, and the *Tahsildar* receives stringent orders to send up the *khataunis* sharp, then the papers are hurriedly prepared and are often wrong and have to be returned for correction, e.g., delay after delay takes place, and you can imagine how handicapped the Canal Department is under such circumstances.

8. But how is the evil to be remedied is the question which is more important than the detection thereof. The remedy that I beg to propose is as follows.

9. We must have separate Canal *Patwaris*, and as there will be no additional expense (which I will explain hereafter), the proposed change will, I am confident, be more than justified.

10. First of all as the canal papers will be prepared in good time and correctly by the Canal *Patwaris* the *abnosh* will be duly satisfied because his troubles above alluded to will be really minimised. Again, under the present system only the *Mirab* (water distributor) appointed from among the leading men in groups of villages has perhaps too much to do with the distribution of the canal water, and is often tempted to favour his rural relations and friends at the cost of his distant neighbours; and the Canal Darogah with his Assistant has to devote all his time and attention in looking after the canal embankments and general progress of irrigation, and has thus hardly time for going into details as regards far distribution of water for each village and each *patti*, and so on. But the Canal *Patwari*, if appointed, will be able to record the *shudkar* to show the progress of irrigation in detail within his circle. This *shudkar* was ordered by Colonel Wnee, late Financial Commissioner, in the eighties, but it has for obvious reasons remained a dead letter more or less, and now if the *shudkar* was prepared as the irrigation is progressing there need be no mistake thereafter in preparing the canal *khataunis* accurately, because when not otherwise engaged

the Canal *Patwari* can well afford to visit each village once or twice a week when the irrigation is in progress and the Canal Darogah, the Canal Naib *Tahsildar* and the Canal *Tahsildar* and the Superintendent of Irrigation can all obcek the "*shudkar*" as they go round and thus avoid almost all future disputes as regards irrigation.

11. Later on when the canal irrigation ceases in September and October the Canal *Patwari* can at once take the "*girdawari*" in hand and prepare the irrigation *khatauni* in good time and distribute the *parchas* to the *abnosh* and send in the *furd tanazzah* to the head quarters. This arrangement, if adopted, will enable us to prepare the *dak bandi* (Canal Budget) in December or January and to start work on a correct date and in good time. Under the present system we have an Assistant Darogah on each canal except on the two largest canals where two Darogahs (instead of one is required). We have also a "*gunya saz*" and sometime two on each canal. The duty of the *gunya saz* is that he checks the digging of each gang of labourers by means of a plumb by starting it from the nearest bench mark (we have 16 *pakka* bench mark in each mile), because the only Canal Surveyor and Overseer that we have for the 13 canals has to go everywhere between the Indbiana district on one side and the Bahawalpur border on the other, and as the work is finished by each gang it won't do to make them wait until the Surveyor comes round, so the *gunya saz* satisfied himself with his plumb that the silt clearance is correctly done and then the gangs of labourers are paid off and discharged. It would be interesting to note here that before we employed those *gunya sazes* the labourers used to pull up the Surveyor's pegs so cunningly above the proposed bed of the canal to save a few inches of digging that it was difficult with the naked eye to detect the fraud; but now the *gunya saz* checks the work as above, and he is responsible to the Surveyor if the work is wrong.

At the same time no labourer is made to wait idly before the surveyor can come round.

12. Now if we have properly qualified Canal *Patwaris* we need have no Assistant or Naib Darogahs and no *gunya sazes* either, for when the silt clearance is going on in the cold weather the *Patwari* who has nothing else to do at that time of the year may well be usefully employed on this work.

13. But the Canal *Patwari* must be qualified as follows:—

- (1) Correct mapping of fields and well versed in '*milan*' identifying fields on spot.
- (2) Good knowledge of fields of various shapes, and how to calculate their area.
- (3) Prepares *khataunis* correctly from *khassra*.
- (4) Sufficient knowledge of arithmetic.
- (5) To write in the vernacular and figures in English neatly.
- (6) To use the '*gunya*' (plumb) correctly.
- (7) To measure up the silt deposited in the canal, and to calculate the cubic contents of all earthworks.
- (8) Last, but not least, to be hardworking and of active habits.

14. Before appointing them all the candidates for the post of the Canal *Patwaris* should be thoroughly examined under a regular system sanctioned by Government, and I have little doubt that many a F.A. or even B.A. failed that would flourish here, there and everywhere would be available for this useful work and in time be promoted to Canal Darogah, Naib *Tahsildars* and so on.

1. Q. (The President)—You are Extra Assistant Commissioner in Ferozepore?—Yes.

2. Q. You have charge of the Ferozepore Inundation Canals?—Yes; I am one of the disciples of Colonel Grey.

3. Q. Were canals begun at that time?—I was *Tahsildar* when the canals were dug in 1876-76-77 under the supervision and guidance of Colonel Grey. I afterwards came to Lahore. When he returned from Furlough I was placed in charge by special sanction of Government of India in April 1881. We started with 70,000 acres a year and now we have come to 3 lakhs a year.

4. Q. You say, "the only defect in the present system is fully discussed in my recent report?"—Yes, a copy of the

report is attached to my memorandum. After writing my report one thing has occurred to me: I think it is a defect in irrigation; the people have taken so much to rice cultivation that it has deteriorated the land: we have even failed to discharge it by charging double rates. I would like to see this rice irrigation stopped first.

5. Q. You are unhappy about the prospects of these canals?—Yes, now I see there is a prospect of damming the river: the few canals above that point will be benefited, but those below it (a larger number) will suffer: we have already suffered on account of the Sirhind Canal; we lose 15 days at the beginning and 15 days at the end. I think it most essential that these canals should not suffer.

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6. Q. What is the Mamdot Estate?—It is an estate under the Court of Wards—a belt of land, 10 miles long and 35 miles broad. We treat Mamdot just like any other body of irrigators, i.e., they pay the *bachh* or establishment rate and do their quota of silt clearance, etc., according to the irrigated acreage.

7. Q. What is the arrangement on these canals?—Suppose a man has irrigated 10 acres, and on his land the silt deposited is 20 cubic feet, we distribute the cubical contents of the silt on the area irrigated; we tell each zemindar so much of your area has been irrigated, accordingly you have to dig so much silt and similarly we distribute the expenses of the establishment on the area irrigated.

8. Q. Is the silt clearance done by the people themselves; is it *chher*?—We call it *dak bandi*. I condemn the use of the word *chher*. *Chher* means that a certain number of men assist in doing joint work. Our system is to allot a fixed task to each. If a man fails he pays double.

9. Q. If a man did not wish to dig and said here is Rs. 20 instead, would you take it?—Yes. Now-a-days a man often does that. We do not charge him double if he pays at once.

10. Q. What is the establishment?—I am at the head; acting as Superintendent, I have general control over both canals and Mamdot. I have an overseer also besides the Assistant Superintendent and the Canal Tahsildar.

11. Q. Now your system was begun in very exceptional circumstances; Colonel Grey devoted a great deal of time to it and so have you. Could you reproduce a system like that elsewhere?—No.

12. Q. What does a man pay you for his water?—He pays only the cost of the extra establishment at about four

nases per acre.

13. Q. (Mr. Rajaratna).—With regard to what you say as to the discouragement of paddy, what is your rate for paddy?—Government charges Rs. 0.12 per acre. I charge about Rs. 1.8, i.e., double charge including the establishment rate and silt clearance.

14. Q. Why do you wish to discourage rice cultivation?—Because I think it not only deteriorates the land but it deteriorates the men. We Punjabis are *chappati-munchers* and have always been soldiers. If we take to eating soft rice our hearts also will become soft.

15. Q. Does your paddy require constant irrigation?—Yes, at least for three months, the thing is a loss as very often it is not half ripe by the time our canals stop; it is only green fodder and this the people cut down and sell in the bazaar.

16. Q. What is the proportion of the cotton as compared with other crops?—It varies; if it is a good crop it may be worth Rs. 50 an acre, if it is bad it is not worth fifty annas; for *chari* or *jadr* a man will get Rs. 25 an acre, but that will be sure.

17. Q. If you have no remission for failure of rice crop will that check it?—Giving no remission would check it. This cultivation is a great temptation to the zemindar; if his rice crop fails he sells the fodder, ploughs up the ground, and sows gram which produces Rs. 15 an acre, and as there is no charge of any kind on such crop the zemindar is tempted to run the risk, i.e., if the rice crop is matured, as it sometimes is, then he gets his Rs. 40 to Rs. 50 per acre, and if it fails, the cultivator utilises the green rice as fodder and cultivates *rabi* on the same moisture with the help of well irrigation and has nothing to pay.

WITNESS No. 28.—RAI BAHADUR GANGA RAM, Executive Engineer, Lahore.

Memo. of points on which Witness offered evidence.

First.—A cheap and efficient method of building irrigation wells.

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In 1891 Rai Bahadur Ganga Ram obtained a patent for a cheap method of building irrigation wells by the use of dove-tailed interlocking bricks, as per plan enclosed. A model will be shown to the Commission. Several wells have been constructed on this plan. There are four in Lahore, and one of them daily worked by Persian wheel. Another is now being sunk at the Aitobison College.

While the wells constructed on this system have proved perfectly successful barring one or two in out-stations, where bad bricks were used for want of supervision, the patentee has dropped his patent because he found by practical experience that it was beyond the capacity of zemindars and ordinary brick-moulders to successfully mould such bricks.

He has, however, invented a simpler kind of brick which will do just as well, and for which he has applied for a fresh patent. The model of this new method will be shown to the Commission. A well on this system has been successfully sunk in *Hansi*.

Rai Bahadur Ganga Ram is of opinion that the only way to encourage the sinking of wells is for Government to undertake their construction, and his system offers a cheap method.

SECOND.

Rai Bahadur Ganga Ram has made a special study of lifting water by mechanical appliances, and is of opinion that the inundation canals, which generally fail in bad years when crops raised on such canals fail to come to maturity often for want of one watering only, could be rendered as useful as perennial canals if they had steam-pumping installation at the head works, or within, say, half a mile of the head, wherever a suitable site could be found. Rai Bahadur Ganga Ram can furnish calculations to show the initial cost as well as the cost of future working of such pumping works. In the very worst years, inundation canals fail for the fall of water level in the river, yet, as a rule, there will be enough water found in the river to feed the pumps.

1. Q. (The President).—You are an Executive Engineer in the Public Works Department?—Yes.

2. Q. How long have you been in Lahore?—For the last thirteen years.

3. Q. Have you had any experience in the Irrigation Department at all?—No.

4. Q. Have you had any famine experience?—No.

5. Q. You have, I understand, a patent for a cheap method

of digging wells. This is a matter outside our reference. If there is a cheap way of building wells we shall of course be glad to hear it, and if it is successful no doubt it will be availed of. For how much would you build a well 30 feet deep?—Exactly half what it would cost now.

6. Q. You have also been turning your attention to water-lifting machinery?—Yes. (Witness read out figures from a memorandum he had prepared, a copy of which he promised to send to the Commission.)

EIGHTH DAY.

Delhi, 11th November 1901.

Mr. J. M.
Campion.

WITNESS No. 29.—Mr. J. M. CAMPION, Chief Engineer and Secretary, Buildings and Roads Branch, Punjab.

Note on the tanks dug during the famine of 1899-1900.

11 Nov. 01.

I personally visited every one of these tanks during the famine time of 1899-1900, and selected the sites for most of them. The sites were all carefully selected with regard to

the following points:—

(a) Situated on a drainage line always, and some within reach of a canal channel.

- (b) Situated within a bit of some good grazing ground for easy convenience of the cattle of 3 or 4 villages.

Before these tanks were started some 6 to 8 trial pits were dug on the site, 18 to 22 feet deep, to decide on depth to go in making certain of the water-holding conditions of the soil. Each one of these tanks was well situated with regard to water-holding conditions; so I do not anticipate any diffi-

culty in this respect when there is a good rainfall. There is no doubt that as these tanks fill, and gradually leak, they will materially help the sub-soil water-supply, in wells, of the locality.

They can, of course, be used for irrigating with Jalas. They must in time be of value to the people of the locality and always be a stand-by for village famine relief works, as they can be extended or cleared of silt; they cannot be silted up entirely, or even moderately.

Mr. J. M.
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1. Q. (The President).—You are Chief Engineer of the Roads and Buildings Branch in the Panjab?—Yes.

2. Q. How long have you been in that capacity?—Nearly two years.

3. Q. Where were you before?—I was Executive Engineer, Umballa, and afterwards Superintending Engineer, Sud Cirrle. I have been in this circle nearly 11 years.

4. Q. You have had charge of famine works?—Twice.

5. Q. What was the arrangement of the programme of works?—In the first famine—the one of 1897-98—we had not a complete programme. We then set to work and made one out.

6. Q. Not until the famine was upon you?—No, we had some idea of works; principally roads.

7. Q. Then action had not been taken upon the Report of the Famine Commission of 1878-79, which recommended that programmes should be made out?—I cannot say without reference to records.

8. Q. The famine was upon you and you commenced roads?—Yes, we had principally roads; there were also a few small village tanks, and we did a part of the Delhi-Agra Railway.

9. Q. Then it was after that famine that you prepared your programme?—During the famine we started making estimates and more complete programmes to help us if famine had not ceased.

10. Q. At the second famine had you the programme pretty well in hand?—Yes, very well in hand.

11. Q. I have your Note in which you mention a great number of village tanks that you constructed?—That was in the famine of 1900-01.

12. Q. With your experience what do you say is the best class of famine work?—For economy, good discipline and good management, there is nothing better than a large tank; although we were fixed to 5,000 on a tank, we have run up to 12,000 some.

13. Q. Was there any difficulty about getting land for the tanks?—None; in one instance we had to pay; each tank was selected with regard to its position for drainage.

14. Q. Have these works been completed?—More or less; some of the tanks have not been taken to their full depth.

15. Q. Then I have this compilation: this is, I understand, your programme since the famine?—Yes, that will be increased after we have completed our investigation of further work that may be added; this programme has been accepted by Government for the present.

16. Q. The technical part is done by your Department; do the Revenue officers go through it?—The Executive Engineer submits it to the Deputy Commissioner, who submits it to the Superintending Engineer; it then goes to the Commissioner and he finally disposes of it.

17. Q. It is the joint work of the two Departments?—Yes.

18. Q. There must, I suppose, be a limit to village tanks?—Yes.

19. Q. Was any effort made to puddle the tanks?—No, the tanks were carefully selected by trial pits for water-holding soil; we put in trial pits of 25 feet and the tank was left to puddle itself.

20. Q. What do you think of road works as famine works?—I should not try them at all unless there is a 12, 10 or 18-foot height of embankment.

21. Q. (Mr. Higham).—Are there any works in your new programme in connection with canals which should be carried out by the Irrigation Department, for instance cut off?—There are one or two: such as the Haripur Cut on the Western Jumna Canal in the Umballa District.

22. Q. Is the Irrigation Department consulted about works that might be included in the programme?—Yes.

23. Q. With regard to the tanks that you have made in the Hisar District, would it be possible to connect any of them with the Western Jumna or other canal?—Yes.

24. Q. Some of the tanks are 20 miles off I suppose?—Yes, many in the south-west of Hisar; some are quite beyond canal reach.

25. Q. Are there any works in connection with the Mar-kanda scheme that have been put in the programme?—No, that has to be investigated; we know a good deal from previous surveys.

26. Q. You are not likely to want relief works in that part?—No.

27. Q. Were there none in the last famine?—None.

28. Q. Have you not dug big tanks at Bhawani for water?—Yes, these tanks were made as a part of the water-works supply scheme.

29. Q. Could not you employ relief labour in puddling them?—No, on account of the scarcity of water.

30. Q. These new tanks are not in the vicinity of the villages?—They are not far; no village was further than three miles from any of our tanks.

31. Q. They won't be of much use at that distance off?—They will be useful for cattle.

32. Q. Did you enlarge any of the existing village tanks?—In the first famine we did; in the second famine it was done under the Civil officers.

33. Q. (Mr. Rajaratna).—Are these tanks capable of irrigating any large area?—The tanks when completed could hold 10 millions cubic feet of water—jalars can be worked along the edge.

34. Q. (The President).—Their primary purpose is not irrigation?—No; they are for cattle drinking purposes.

35. Q. (Mr. Rajaratna).—You say puddling was dispensed with—Could that have been done if the works had been constructed in ordinary years?—I don't think so; they will after a time puddle themselves: the cost of puddling would be too great.

36. Q. Did you try breaking of metal for roads?—We tried it in the first famine, but it was not successful; in collecting kunkur it was difficult to get a task owing to the varying depth of the kunkur; that disturbed our arrangements in regard to task and discipline; the whole work consisted of quarrying, if you could fix the depth of the kunkur you could make a good task of it; in any selected area you won't find kunkur the same depth throughout from the surface or the same thickness.

37. Q. (Mr. Ibbotson).—You say that in the first famine you had no programme of works. Were not returns prepared of people provided for?—As soon as we knew that the famine was coming we searched for projects and made out a list of these gradually—at the same time as the famine was going on we were hunting up all projects and estimates.

38. Q. Can you say why, in spite of the Code, no programme was made out; to what do you attribute the fact that there was no programme?—There may have been programmes. I cannot say for certain without a reference to records.

39. Q. You didn't find them of much help; they were insufficient?—Yes, we were going on with further projects and making estimates from the very beginning of the famine.

40. Q. You have a new programme here in which you show how many thousand men have been provided for and for how long in each district; would it not be useful to take the actuals of the last famine and put them in for comparison?—Yes, it would be better; we had a percentage for the last famine of the population of each district.

41. Q. How are you to know how this programme will turn out unless you have some check of that sort?—We have figures to show what was the maximum percentage that came on to works then.

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42. Q. Have they been compared with these figures?—No, we have only a percentage recorded.
43. Q. Is it not very important to compare the figures in order to ensure that your maximum is sufficient?—Yes.
44. Q. You say your programme will be increased when you have finished your investigation; what investigation is that?—With regard to nay better works or more works that we can put in to this last programme.
45. Q. Have you men out making an enquiry?—Yes, in every Circle.
46. Q. Are they special men?—No.
47. Q. How long will the work take?—Two or three years.
48. Q. Will that include village works?—No.
49. Q. It will take two or three years to finish this programme for Public Works only?—Yes, we have quite a number of projects at present in hand.
50. Q. Does that two or three years provide for the completion of the schemes or merely a survey of the country?—I think the schemes will be completed.
51. Q. (Mr. Ibbetson).—Would it include the sinking of trial pits to test the locality for the suitability of n tank?—Yes.
52. Q. You say kunkur-quarrying is not a suitable famine relief work. In Rohtak provision of that sort is included (referring to programme)?—I have submitted the question to His Honour the Lieutenant-Governor; I think kunkur-quarrying and stone-breaking can neither of them be carried on economically.
53. Q. I suppose these were included because you had difficulty in finding other suitable work?—Yes.
54. Q. Have you a map showing the distribution of these works?—Yes.
55. Q. Supposing you show in your programme works sufficient to employ 10,000 men for six months—what security there is that they are distributed fairly well all over the district?—The Civil officers will see to that.
56. Q. You show them on the map to enable that to be checked?—Yes.
57. Q. Is the map printed?—It will be published when

the projects are ready and copies will be given to the officers concerned.

58. Q. What about the works on the border of a district?—We would show such works in the estimate of the district in which they are located; that would be shown on the map and left to the Civil officers to decide which district should take it up.

59. Q. In Rohtak and Hissar you have the greatest difficulty in finding works?—Yes, there is nothing except these tanks and a few roads.

60. Q. The drainage works in the Markanda are at a reasonable distance from Rohtak; could you not take people there?—Yes.

61. Q. As regards village works there are an enormous number in the programmes; there is no doubt that village works will assume greater importance in future famines than in the past; has any sort of examination been made of these works?—Yes, we have examined them.

62. Q. For instance, have you sunk trial pits?—Yes.

63. Q. And whatever is necessary is being done or has been done?—Yes.

64. Q. You think that these investigations will take two or three years?—Perhaps they will be done in less time if a special establishment is put on; it depends upon the ordinary works of the Province; if it was in my power I should have it done in 18 months.

65. Q. What sort of special establishment would be necessary?—To each district I should put on two or three surveyors, a draftsman, an ordinary District Engineer and a man who could level and survey, all working under the Executive Engineer of the Division.

66. Q. What would be about the cost?—I should give an Engineer Rs. 350 a month, three surveyors Rs. 50 each and there would be Rs. 50 for khakhsais; something like Rs. 600 or Rs. 700 a month in each district.

67. Q. Would all these works be constructed in the ordinary course?—No, they would not be done in the ordinary course.

68. Q. A great part of your programme will stand until the next famine?—Yes.

69. Q. You would not want to keep the special establishment permanently?—No, certainly not.

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Witness No. 30.—MR. H. J. MAYNARD, I.C.S., Deputy Commissioner, Umballa.

Memo. by Witness on Protective and Relief Works in the Umballa District.

1. The Umballa District occupies about 1,700 square miles of the plains between the Sutlej and the Jumna, together with nearly 100 square miles of hill country (the Jumna tract) and some of the southern slopes and valleys of the lower hills. Roughly, the plain portion of it is a sub-montane strip, 70 miles long by 20 wide, with a continuation (the Umballa taluk) projecting out of the sub-montane area in a south-westerly direction. Beside the Sutlej and Jumna, it is watered by four practically perennial streams (the Sirsa, the Ghaggar, the Markanda and the Som), and is crossed by a large number of hill torrents, the beds of which are empty except after rain. The average rainfall varies from 40 inches under the hills to 25 inches at the point furthest from them, but is irregular and capricious, and very frequently does not suffice for the growth of rice in the hard clay tracts where this crop is the staple. The district is almost equally subject to flood and to drought, and in the present season revenue is likely to be suspended for the former cause in the Jumna Valley and for the latter cause in the tract furthest from the hills, and in the autumn of 1900 some of the villages which had not yet recovered from the drought were much injured by flood. Of its total area of 1,831 square miles, 1,164 are cultivated. Serious drought is so rare in the sub-montane area that two fifths of the district are technically classified as secure; and the history of the two scarcities in 1896-97 and 1899-1900 appears to show that famine of a widespread character need not be apprehended anywhere.

2. Of a total cultivated area of 750,000 acres (giving 1 acre per head, if the population of the Cantonment be excluded) about 100,000 acres are secured from drought by the six streams already mentioned, together with the Western Jumna Canal (which gives water to 2,500 acres only). The Sirhind Canal (which also has its head works within the district) furnishes no irrigation. In the remaining 650,000 acres there is a tract known as the Udhia and Chara Circles of 80,000 acres of cultivation, in which good wells provide

prominently for the irrigation of more than one-seventh and can, at a pinch, double the service done, unless disease or sudden famine undermines the strength of the bullocks. Outside these areas wells provide for not more than 1 or 2 per cent. of the cultivation, and cuts from the hill streams and irrigation by a simple process from tanks and depressions, for a rather smaller amount. The empty hill streams furnish an unexpected resource in times of drought. In and near their courses is a perennial, though small, supply of moisture; and in the year 1892-1893, when all the uplands were brown with drought, the valley of each stream was a narrow strip of green-growing crops without watering, bordered on either side by a small area in which cultivation was possible with the aid of shallow pits worked by hand levers. Fourteen thousand such *laheeta* wells were sunk, and gave a supply (somewhat inadequate, it is true) to about 7,000 acres of cultivation. In these two ways the hill streams protect perhaps 20,000 acres, and a large proportion of the sub-montane villages enjoy a share in this small advantage.

3. Along the whole length of the district, next below the hills, lies a strip of broken land, widening towards the south-east, scarred with ravines and sometimes strewn with stones. In this tract the water flows off the fields with great rapidity, and the unevenness of the country is prohibitive of systematic irrigation, except by an occasional cut from a stream, while the water level is sometimes from 70 to 100 feet below the surface. In portions of this tract where the soil is of a suitable character the levelling and embankment of the fields is a good investment for labour, and something has been done in this direction by the more industrious tribes. Beyond is a smoother country, increasingly level and, up to a certain point, tending to increase in fertility in proportion to its distance from the hills. The original soil of the district seems to have been a hard iron clay. This is more or less completely overlaid by a deposit of sand or silt brought down by the hill streams. It is the

quality and depth (and also perhaps the periodical renewal) of this deposit that determines the fertility of the soil. Where there is none, the land is a hard iron clay, capable of growing little except inferior rice, choked with coarse grasses, and rebellious to the plough except after abundant rain. Where the denudation of the lower hills has impoverished the character of the silt which the streams bring with them, as is widely the case in the north-west portion of the district, the good loam brought in former times is sometimes overlaid by a destructive stratum of sand. When quality and quantity are alike generous, the fields bear good harvests with moderate rainfall. It is no uncommon thing to find that an unusual flood has turned clay into loam and altered the agricultural condition of a village: and this happy accident is one which occurs even further south than the limits of the Umballa District. A system of dam storage which had the result of holding up the richer particles and, so to speak, filtering the water might deprive it of its most valuable attribute.

4. Another of the functions of the hill streams of the district is the erosion of cultivated land, which is constantly in process, with the recompensation of gain by alluvion in some other quarter. This necessitates quadriennial and sometimes more frequent remeasurement, which also extends to villages affected by the tendency to the formation of ravines owing to the "cutting back" of local drainages. Much useful work could be done by the erection of bunds, combined with the planting of flood-resisting grass (bind pua or jhund), but isolated and amateur efforts are apt to be infructuous even to do mischief by diverting the force of a torrent from one bank to the other. A systematic professional survey of each stream in turn, which would forecast the effects of local action, both in regard to erosion and silt deposit, along its whole course, would disclose the possibility of many profitable protective measures, and furnish a good portion of the district with an inexhaustible programme of relief works. For small local works, particularly in the ravine scarred strip below the hills, the embankment and terracing of fields to stop "cutting back" should prove a useful resource.

5. The hard clay lands constitute one-fourth of the total cultivation in the Umballa Tahsil, which is also furthest from the hills and has the lightest and most capricious rainfall. There is one possible project, to which allusion will again be made, for conveying the fertilising waters of a hill stream to a portion of this tract. Apart from this the best prospect for the clay lands appears to be in the development of tank irrigation. A favourable feature which has made its appearance on the clay lands generally since the settlement of 1858 is the increase in the cultivation of *siri*, or fine rice, at the expense of the coarse variety, and the seedling beds of *siri* are commonly watered from tanks. In the north-western tahsil (Rupar) the clay cultivation is insignificant in quantity; in the other tahsils, proceeding to a south-easterly direction, it amounts to about 8, 10, and 6 per cent. respectively, but in the two latter it is not of such an uncompromising character as in Umballa, and the admixture of loam lands is greater.

6. Taking the district as a whole the water-bearing stratum is not favourable to the construction of rain-water wells. In the Umballa Tahsil, in particular, there is below the clay soil a light sandy shifting stratum, giving a very deficient water-supply. When the surface soil is thin it is liable to sudden subsidence, and the small channels thus formed are well known under the name of Umballa holes. Elsewhere, and to a less extent even beyond the limits of the tahsil, the shifting sub-soil makes it impossible to sink irrigation wells which can be worked efficiently for more than a very few years. Some of those which exist are kept as a last resource for years of unusual drought and, if used persistently, would soon break down. These remarks do not apply in the Dhina and Chara Chieles, where, as already mentioned, a tract of 80,000 acres of cultivation is practically secured by wells; nor in the south-east, where the water-bearing stratum is good, though much less utilised; and in the valleys of the Sutlej and Jamma at a short distance below the point where these rivers issue from the hills, it may be said that wells are cheap to make and easy to work, but are little needed and little used. Everywhere a good supply of manure is required with artificial irrigation, and this involves a good supply of cattle.

7. Revenue arrangements put no artificial discouragement in the way of well sinking. In earlier settlements there was a tendency to over-assess well irrigation owing to ignorance of the cost and labour involved, and possibly the tradition may have survived to some extent. The people themselves are said rarely to charge well lands at more than

double the rate of dry, but Settlement Officers generally go above this standard. However, a new well cannot be made a ground for an addition to the assessment during the currency of a settlement, and a protective lease can be secured guaranteeing exemption for it for a period of twenty years. In the internal distribution of the revenue within the village the usual system was to put a lump assessment on each well according to the area irrigated by it for the preceding three or four years, to distribute this lump sum over the irrigators according to their shares, and to add the resulting well assessment to the revenue imposed on each of the holdings concerned in their unirrigated aspect. If a well falls out of use (as very commonly happens in the Umballa Tahsil owing to the uncertainty of the water-bearing stratum) the assessment upon it cannot be remitted during the currency of the settlement; but the Revenue Officer can, for sufficient reasons, redistribute the demand over the village, thus relieving the individual while maintaining intact the responsibility of the whole coparcenary body.

8. The true reason why wells are not sunk in greater numbers is perhaps disclosed by an analysis of the crops which are grown on them and of the classes which resort to this form of irrigation. Wheat, maize and cane are the staples of well irrigation in the Dhina and Chara Chieles: they are also grown on wells elsewhere, but vegetables, chillies, tobacco and opium are the most common products. It is laborious, as well as expensive, to work wells, and as drought is only occasional, the easy thrifless man would do well enough with less work and less outlay. When laid put to it, he will perhaps sink an unlined well to be worked with a hand lever, and make shift to get through a bad season thus. Even if he had the foresight to be prepared in advance against a decennial calamity, it would perhaps be a bad investment for him to incur the outlay required. The water level varies from 8 feet in the valleys to 25 or 30 in the uplands, with a far greater depth in the rough country under the hills. With water at 20 feet a single bucket well costs about Rs. 400, and irrigates from 5 to 10 acres in an ordinary year: but well bullocks must be finer and stronger than those which suffice for the plough, and as there is broadly speaking no grazing except in the hills and close under them, they must be fed by the growth of an increased area of fodder crops. In these circumstances there is little wonder that well irrigation should be so largely in the hands of Malis, Ruins, and other market-gardening castes, with small holdings, large families and traditional habits of laborious industry. In the Dhina and Chara the sturdy Jat puts his savings freely into well construction and the purchase of expensive bullocks; but he looks with something of an envious eye on the easier life led by his brother on the loan lands that depend on rain.

9. Very little recourse is had to State aid for the sinking of wells: and no measures for the facilitation of such aid or the improvement of the terms on which it is given would lead to an appreciable extension of irrigation. The unlined hand-lever wells, which constitute such a valuable resource in times of drought, are constructed at a cost of Rs. 10 a piece or less, and no advances are required to encourage the sinking of them. Well irrigation will only increase with the purchase of land by the Sainis, Malis, Ruins and Kambhars, a process which is steadily going on, and which the arrangements made under the Punjab Alienation of Land Act have happily done nothing to check. The expansion of these thrifty and prolific tribes takes place for the most part at the expense of proprietors who have more land than they can farm with profit, and carries with it an improved and intensive cultivation.

10. In the case of the River Ghaggar which irrigates 8,000 acres by means of kuls or cuts, the existence of political and private rights is a barrier to the economical use of an excellent water-supply. In their upper course the waters are divided, according to long standing custom, in stated proportions between British territory and the Patiala and Kalshi States: and, within the former, between different British villages. The division is notoriously uneven, and some places get far more irrigation than they need, with the resultant injury to the public health and the fertility of the land: but no one can afford to abate his customary claim lest, in a year of exceptional drought, his diminished share should prove inadequate. To the west and south-west stretches a tract of iron clay, thirsty for water but deprived of it. Lower down, the Ghaggar passes through Patiala territory within a few miles of the most insecure portion of the Umballa Tahsil, which has been cut off from its natural supply of water on the opposite side by the necessity of protecting the Cantonment against flood. The old irrigation cuts from the

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Ghaggar to this tract still exist: but the Patiala authorities have long ceased to allow any water to be taken, and if there ever was a right it is now extinguished by lapse of time. The British villages which are thus deprived of a regular supply of water for irrigation are nevertheless subject to occasional destructive floods when the embankments in Patiala territory are breached.

11. In the famine of 1896-97 Rs. 20,000 were expended on the construction of new tanks, valuable mainly for the supply of drinking water to cattle, and a small additional sum was expended on roads and repair of tanks. In 1899-1900 famine was never declared in the district and tank works being regarded as unsuitable as tests of the existence of distress, the money expended (under Rs. 9,000) was devoted to a scheme for the improvement of the sources of the Municipal water-supply, with a few petty road works. The existing programme of relief provides for 62 million cubic feet of earthwork, which is sufficient to give 23,000 labourers work for six months. The irrigation works on the list include a cut off for the straightening of the Western Jumna Canal at Haripur (2½ million cubic feet) and the excavation of three new tanks (28½ million cubic feet) which will probably supply water for drinking purposes. The rest is made up of cleaning and improving old tanks, road construction and the breaking of stone ballast for the Delhi-Umballa-Kalka Railway. The programme can only be regarded as provisional, and is susceptible of improvement both in regard to the works provided and their distribution over the district. The tract in the south-west which I have already alluded to as most likely to suffer severely in drought is not provided with any local programme at present.

12. Besides the systematic survey of hill streams with a view to protection against erosion and sand damage, the development of tank irrigation for food rice, and the terracing and embankment of fields in the rough tract under the hills, the following are possible projects:—

- (1) The development of an existing cut connecting the Tangri and Tangra Streams so as to give systematic irrigation to the iron clay tract which lies to the south of Umballa. A note on the subject was made over to the Engineer on special duty for the preparation of famine projects last spring, and it is doubtless under consideration.
- (2) Restoration of old irrigation channels from the Ghaggar so as to give water, as formerly, to a portion of the same tract. This is, physically, a very simple matter, but it depends on the consent of the Patiala Darbar. The Settlement Officer, Patiala, has undertaken to consider the matter.
- (3) Construction of a cut from the Sirsa River to irrigate some 500 acres of land in the north of the Rupar Tahsil. This was actually carried out by private arrangements during the drought of 1899-1900: but ultimately broke down owing to opposition from a village whose lands were crossed by the cut. An officer with professional knowledge might find a method of developing the irrigation from this source. The cut runs in the direction of an old Moghul canal (known as the Mirza Kandi) which is still traceable along a depression from north to south in the Rupar Tahsil.

- (4) Storage of water in the hills north of the Naraingarh Tahsil. The Mir of Kotaba, an important Jagirdar and land-owner of this neighbourhood, asked for professional assistance in the spring of 1900 to investigate the possibility of utilising the supply in certain tanks or lakes and in one of the hill-streams (the Taugri) for this purpose. The Executive Engineer had not time to investigate the proposals (which were of a vague character). I have since made a communication on the subject to the officer on special duty in connection with famine projects, who will probably consider it when more urgent work has been disposed of.

13. There remains one point to which it is worth while to draw attention in connection with the administrative organization for the preparation of projects of protection and relief. The Public Works Department has its own roads or buildings to attend to (or, in the case of the Irrigation Department, its own canals), and its officers cannot be perpetually wandering about the country seeking for possible projects. The District Officer, on the other hand, must perpetually wander in the course of his revenue work: it necessarily devolves upon him to put forward suggestions: and his attention is frequently drawn to defects and possible improvements; but he does not and cannot look at things with the skilled eye of an engineer, and is therefore a bad judge of the feasibility and reasonableness of the projects which suggest themselves. His proposals, in regard to irrigation and drainage at all events would be less apt to be wide of the mark, if the maps which are ordinarily available showed the height the country above sea-level at a larger number of points than they show it at present. But, in any event, unless he is usually confident of his own insight into such matters, he will hesitate much before he asks a busy Executive Engineer to investigate his own shadowy scheme: and however confident he may be, he may find that the Engineer, owing him no sort of allegiance, is not over-ready to investigate them. Thus a zealous District Officer may fail to utilise his local knowledge, and on the other hand it may happen that a zealous Engineer, having to deal with a District Officer who is not interested, will fail to find materials on which to exercise his professional skill.

14. The remedy perhaps lies in transferring responsibility for the preparation of projects suitable for inclusion in a famine programme or for execution as protective works to the District Officer, thus compelling him to search for appropriate works, if apathetic, or to give tangible shape to them, if simply diffident, and at the same time to give him an authority over the local Public Works Department official similar to that which he already has over a Deputy Conservator of Forests or a District Superintendent of Police. This harnessing of local knowledge to professional skill, combined with the transference of responsibility to the former, will certainly tend to the more complete utilisation of both. The recent appointment of Engineers to investigate famine projects appears to be of the nature of a temporary measure. These officers will not prepare final programmes once for all, for there must in the nature of things to perpetual revision and alteration, which will necessarily devolve on the permanent functionaries of the department, and be best performed by them after the necessary adjustment of official machinery has been effected.

1. Q. (The President). You are Deputy Commissioner of Umballa?—Yes.

2. Q. How long have you been there?—Two years. I was there for a short period before.

3. Q. Where else have you served?—In Karaol; also in two frontier districts for a short time.

4. Q. Do you know this side of the country pretty well?—Yes, fairly well.

5. Q. With regard to what you say in your memorandum is this technical classification of secure and insecure areas recognized by Government?—Yes, it is; & these are classed as secure.

Mr. Wilson.—Explained that the classification is made out by Settlement Officers in each district.

6. Q. (The President).—You refer to the Sirhind Canal. Is any irrigation done in the Umballa district by the Sirhind Canal?—None at all; it irrigates bits of Patiala.

7. Q. Wells are not generally used in your district?—No, except in one small tract—Dhaia and Chara.

8. Q. You say in paragraph 8 "the true reason why wells are not sunk in greater numbers is perhaps disclosed by an analysis of the crops which are grown on them and of the classes which resort to this form of irrigation in the Dhaia and Chara Circles, they are also grown on wells elsewhere, but vegetables, chillies, tobacco, and opium are the most common products." Do you think the labour is too great for them to go in for an extension of wheat?—The water stratum is so bad that it does not pay the people to go in for irrigation unless they intend to grow valuable crops such as vegetables and opium.

9. Q. Why bad?—There is a thick clayey stratum; a well was sunk at Umballa in 1879 and they stopped at 700 feet and they were still in the clay.

10. Q. The whole area of the district is 1,800 square miles; & these are secure and & these must depend on the exten-

sion of irrigation?—I think it is a wrong classification. I don't think they are likely to suffer from famine except in a very small area.

11. Q. Practically in no part of your district?—Not of widespread famine.

12. Q. What has been going on in the last few years?—In 1896-97 there was a so-called famine, but it did not spread to any extent; the suffering fell mainly on the townspeople and menials, who had to buy their food; the zemindars did not suffer seriously. In 1899-1900 we did not get to the stage of relief works; the test works did not draw.

13. Q. Are there any records of famines in past years?—Yes, of a scanty kind.

14. Q. Did the famine of 1866 affect Umballa?—Yes, to some extent.

Mr. Ibbetson.—Explained that witnesses was talking of the district as it now stood. Pipli, the worst portion of the district, had been transferred to Karnal.

15. Q. (The President).—I understand one reason why there is no well irrigation is owing to the uncertainty of results in sinking wells?—Yes.

16. Q. Would it be a boon to the people, do you think if Government carried on experimental boring?—I think it would be a good thing; in some cases the people would be glad to be lent boring machinery. I had an application from a man the other day.

17. Q. If they were sure that they would get water at say 20 to 30 feet, there would be an extension of wells, do you suppose?—Yes, but it often happens that the water supply fails suddenly in a well that has been working all right for some time.

18. Q. The expert employed would have to be a man of some geological knowledge. From the experiments made in 1879 the clay must be very thick indeed; what is below the clay?—I don't know.

19. Q. (Mr. Ibbetson).—The result might very often be to discourage rather than encourage a man?—Yes, possibly. On the whole I fear it would not be much good.

20. Q. (Mr. Wilson).—Are there alternative layers of clay and sand?—Yes.

21. Q. Does the clay vary in depth?—There are not a sufficient number of experiments in deep sinking to be quite sure about that; there has been a well made by the railway in which they have secured a supply at no very great depth.

22. Q. You say in paragraph 10, talking of the Ghaggar, "lower down the Ghaggar passes through Patiala within a few miles of the most insecure portion of the Umballa tahsil which has been cut off from its natural supply of water on the opposite side by the necessity of protecting the cantonment against flood?"—Yes, there was a stream which passed over the ground now occupied by the cantonment; it deposited a good deal of silt and no doubt was useful; the cantonment made bunds and turned all the water off.

23. Q. Where does the water go now?—It flows east.

24. Q. (Mr. Ibbetson).—Was compensation given?—No, it was done a long time ago.

25. Q. (The President).—During the famine of 1896-97 where were you?—I was in the Secretariat.

26. Q. Did you find a programme of famine relief works ready in your district?—Yes, there was a programme.

27. Q. Does its preparation come under your personal supervision?—Not exactly; the list comes to me for remarks, I am not responsible for its preparation; my remarks would be merely criticisms of the proposals put forward.

28. Q. Is it conscientiously kept up year after year?—It is revised every year; I don't think the revision is looked on as a very serious matter.

29. Q. I suppose it is a distinct order of Government that it should be kept up?—Yes; the difficulty is to find suitable works; the tendency is to make it a *mamuli nakshu*, particularly in Umballa which is not likely to suffer seriously.

30. Q. I suppose year after year the programme is practically the same?—Yes.

31. Q. You say in paragraph 12 that the storage of water in the hills north of the Naraingarh tahsil is a possible project; is there reason to suppose the water can be stored?—I should think it possible, but I am afraid that it is a matter on which I could not express an opinion.

32. Q. Has any professional examination been made?—No.

33. Q. Who is the officer you refer to in paragraph 12?—Mr. Warneford was an Special duty, but was taken off; I don't know who has been put on to take his place.

34. Q. You make a proposal as regards the transfer of responsibility to District Officers; has not the District Officer many other things to do?—It would make his work easier, give him responsibility and strengthen his hands.

35. Q. Do you think the Deputy Commissioner would have the time personally to attend to the subject?—He is bound to do so in the course of his journeys; the Public Works Officer will only go to a point where he has to go; the Deputy Commissioner is bound to travel all over his district and would get more local knowledge.

36. Q. (Mr. Ibbetson).—As regards the preparation of the programme, before it was drawn up and before criticisms were made, had you an opportunity of making suggestions?—Yes.

37. Q. I don't quite understand what alteration you would propose?—I should certainly (if I were responsible now) press the Executive Engineer to investigate some of the ideas I had.

38. Q. When that programme is revised next year, won't the first thing be to ask you if you have any suggestions to make?—Yes, it will.

39. Q. What further opportunity would you wish to have?—When it is sent to me I should hesitate to put down my crude ideas unless I was responsible; if I were responsible, I should ask the Executive Engineer if there was anything in my crude ideas. I should be unwilling to ask him to take up a piece of heavy work as matters now stand, perhaps there would be nothing in it.

40. Q. You say in paragraph 2 "there is a tract known as the Dhana and Chara Circles of 80,000 acres of cultivation, in which good wells provide permanently for the irrigation of more than one-seventh and can at a pinch double the service done". Would the number of wells have to be doubled?—No.

41. Q. There is one tract in Umballa which is distinctly a well-protected area; in that tract is there room for extension?—Very little.

42. Q. As regards the remainder, you have said one way in which we could help them is by boring; can you suggest anything more to stimulate wells where they would be useful as a protection?—I believe that by encouraging Saini Mali and Kain colonization we should produce that result.

43. Q. Are there vacant areas?—Yes.

44. Q. In a Gujar village if you could get the Saini Malis and Kains to come do you think the villagers would be glad to have them?—Yes.

45. Q. What could be done to stimulate that?—Very little except by persuasion of intelligent individuals and by withdrawing artificial barriers in the way of transfer of land such as the Punjab Alienation of Land Act.

46. Q. Do you think our period of exemption from wet assessment is sufficiently liberal?—I do not think the fear of enhanced assessment prevents a man from digging a well.

47. Q. Do you think the 6 per cent. rate of interest prevents him from taking a *takavi* loan?—No, he looks upon that as an extremely low rate.

48. Q. Could we do anything to encourage the taking of *takavi* loans?—One is never quite certain how far one may encourage the zemindar; it is possible that if I went round and encouraged them to take *takavi* they would apply for it; but there may not be money afterwards to give them.

49. Q. In the last famine the number of *kachcha* wells went up enormously; they afforded substantial aid in a year of drought?—Yes.

50. Q. Was *takavi* liberally given to them?—No.

51. Q. Would it have been taken if you had the money?—Yes, but the people would have eaten the *takavi*.

52. Q. Do you think there were some people who would have taken *takavi* and could not make wells because they hadn't the *takavi*?—No, I don't think so.

53. Q. You don't think if you had say one lakh to give out as *takavi* it would have really had much effect in getting wells made?—No.

54. Q. Have any storage tanks ever been made?—No, except by the people.

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Mr. H. J. Maynard. 55. Q. Have they made them to any great extent?—No, they utilize any depression that there is; for instance they utilize for irrigation the borrow pits along the line of railway. 11 Nov. 01.

56. Q. Do you think that the protection which these tanks would give would be sufficient to justify Government in making them at its own expense by grants-in-aid?—I think if Government made a tank and then levied a charge—a certain water-rate—the people would be glad to give the land and pay rates; they would not do it themselves, there is not enough cohesion among the villagers.

57. Q. Would it give a reasonable return?—I cannot say.

58. Q. You say in paragraph 6 that everywhere a good supply of manure is required with artificial irrigation; have you any experience of irrigation on land where manure is not used?—No, I have not, I have only heard it said.

59. Q. As regards redistribution of assessment over a village when a well falls in; have you known that done?—No.

60. Q. Don't you think it should be done?—Yes.

61. Q. It has been said to us that the difficulty would be that other people would look upon it as unfair, do you think that would be a real obstacle?—I don't think they would look upon it as unfair.

62. Q. You say that one obstacle to the sinking of wells is that a well in an ordinary year is a bad investment?—Yes, because you can get along without it.

63. Q. If you reduced the cost by a grant-in-aid with easy conditions as to repayment how would that work?—It would be at the cost of another evil.

64. Q. Do you think the protection would be worth the cost?—No, I don't; it must be a matter of personal feeling. I think the demoralising effect would be worse.

65. Q. Putting that aside, as regards the area protected, do you think it would be worth the while of Government to enter upon a scheme of that sort, partly at Government expense as a protection against scarcity?—My impression is that the water is not to be depended upon and that it would not pay Government.

66. Q. You say in paragraph 8 that a single bucket well irrigates from 5 to 10 acres in an ordinary year; that is a small area?—I took that from the Settlement Officer.

67. Q. You say in paragraph 11 that a tract in the south-east which is most likely to suffer severely in drought is not provided with any local relief programme; did you suggest any works for that tract?—Yes, one.

68. Q. In the revised programme that may be included?—I have been told that it is not a feasible scheme; I think that tanks are probably better because they are smaller and more easily arranged.

69. Q. You are prepared to suggest tanks in the next programme?—Yes.

70. Q. (Mr. Higham).—With reference to the proposal to utilize these hill streams, is it not a fact that the streams are charged very heavily with sand?—Some with sand and some with silt.

71. Q. What about the Sirsa?—It is very heavily charged with sand.

72. Q. Has anything been done to re-afforest the Sawalks?—Nothing has been done in Umballa.

73. Q. (Mr. Wilson).—You say in paragraph 9 that "very little recourse is had to State aid for the sinking of wells, and no measures for the facilitation of such aid on the improvement of the terms on which it is given would lead to an appreciable extension of irrigation." I understood you to say just now that if you went about, encouraging the people to apply, they would do so?—If I knew Government would give the money I might foster an artificial demand; I think the people would require persuasion.

74. Q. Would it not be profitable for them and for the State?—No doubt.

75. Q. Supposing all obstacles were removed and that you could get as much money as you required and free of interest; and supposing an officer were sent to give the money to the people on the spot, would there not be people willing to take it?—There would be a rush, but it would not be to the people's advantage to nurse them into irrigation and perperize them by grants-in-aid. If there was a sure supply well irrigation could be extended considerably, but many of our wells dried up absolutely and a large number partially in 1890. No doubt some area of crop was preserved, but it would be a bad commercial investment to build wells purely as a protection against drought.

76. Q. About the classification of areas as secure and insecure, is it not the case that "insecure" is an area not necessarily subject to famine but one which requires to be specially looked after by the Deputy Commissioner chiefly with a view to suspensions in bad times?—I don't know; then the classification is misleading in the light of recent experience. Heavy suspensions had to be given in 1890-1900 in the so-called "secure" tract.

77. Q. You say in paragraph 4 "a systematic professional survey of each stream in turn would disclose the possibility of many profitable protective measures." Has any systematic survey been undertaken?—No, except as regards the upper streams which affect the Sirhind Canal.

78. Q. You wish to have a similar survey with regard to the other streams in the district?—Yes.

79. Q. That survey will have to be done by Government.—Yes, the District Board could not manage it.

80. Q. You say in paragraph 7 "if a well falls out of use the assessment upon it cannot be remitted during the currency of the settlement, but the Revenue Officer can for sufficient reasons redistribute the demand over the village." You mentioned that no such case had occurred to your knowledge?—No.

81. Q. You as the Collector have the power to redistribute the demand in such cases?—Yes, but I should wait to be asked.

82. Q. Are there not many men paying assessment of wells that have fallen out of use?—I don't think there is a large number.

83. Q. Is the other shareholders' agreement necessary for such a redistribution?—No. If they objected I should overrule their objection.

84. Q. The question of artesian wells has been, I see, discussed; an attempt was made to sink a well in 1869?—Yes.

85. Q. It was not successful?—No.

86. Q. Is there any chance of its being successful elsewhere in the Umballa district?—I cannot say I have nothing to go upon.

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WITNESS No. 31.—MR. J. J. MULLALY, Superintending Engineer, Western Jumna Canal.

Memo. by Witness.

Preliminary.—The total culturable area commanded by this canal is 2,144,847 acres; whereas the area irrigable by the present project is only 870,500 acres or 40 per cent. The canal could therefore be pushed out to irrigate immense areas, if only more water were available. All the new areas would be either the Hissar or Rohtak District; these districts are notoriously subject to scarcity so that it is of the utmost importance to look round for further supplies of water.

2. Economies effected by latest remodelling schemes.—As a first step in the direction, the whole of the outlets on this canal have lately been remodelled with the result that some water will be set free for extensions. Much of the commanded area in the Karnal and Delhi Districts has had too much water, but the vested interests were so strong that in remodelling the outlets it was considered necessary to distribute the supply, which was taken away from the over-

irrigated lands of a village, to such parts (if any) of the same village as had received no supply hitherto.

The total saving may, however, be put down at 300 cases all the year round, which will be distributed to fresh areas in the lower reaches of the canal. This supply will, with a duty of 150 acre-, irrigate 45,000 acres, and will protect an area of $4 \times 45,000 = 180,000$ acres of new culturable country or say, 240,000 acres gross. The policy of taking water away from over-irrigated fields and distributing it to dry fields in the same village will keep up the percentage of irrigated lands in the village of the older tracts.

3. Further economies now being proposed.—I have already stated above that certain tracts in the Karnal and Delhi Districts are over-irrigated, and I am therefore submitting proposals for giving only one watering in the cold weather for crops which are grown in areas in which the sub-soil water is 15 feet or less from the ground surface.

In this I am only following the lead of the Bari Doab, Sirhind and Chenab Canals. If my proposals be accepted we shall set free about 1,300 oases in the cold weather end, as the river can supply plenty of water in the hot weather we will be able to give water all the year round, to 150,000 acres of new land, and protect $4 \times 150,000 = 624,000$ acres of cultivable country, or say 80,000 acres gross, thus bringing up the total extensions of irrigable area to 201,000 acres. The total area irrigable will then be $870,600 \times 201,000 = 1,071,600$ acres, and the percentage of the cultivable commanded area which the canal will then be able to irrigate will be 30.3.

4. *Further Rabi supplies greatly needed.*—When we have transferred the *rabi* supplies from over-irrigated to famine-threatened areas however, our resources will have been exhausted and immense areas of good cultivable land will still remain crying out for water. This time is rapidly approaching and it is of the utmost importance to look round for new supplies. The minor hill streams only flow in the rainy season when there is plenty of water (and a much more regular supply of it) in the river Jumna, so that the minor hill streams are quite useless in the tracts protected by the Western Jumna Canal.

5. *Distribution of supply between Eastern and Western Jumna supplies.*—We need cold weather supplies and the only resource is to examine carefully the distribution of the river supplies between the Eastern and Western Jumna Canals.

At present when the river supply is insufficient for the needs of both canals, i.e., generally from 1st October to 1st May, the Western Jumna Canal takes two-thirds of the supply and the Eastern Jumna Canal takes one-third.

Now Appendix A attached to this note gives the figures for commanded area, irrigable area, etc., of the Eastern Canal as found in the North-Western Provinces Irrigation Revenue Report for the year ending March 1899, and it will be seen that the cultivable area commanded by the Western Canal is more than three times as large as that commanded by the Eastern Canal. It will also be seen that the percentage of the cultivable commanded area of the Eastern Canal, which can be irrigated by the present project, is 51 per cent. If this proportion of the Western Canal commanded area were irrigable, the acreage irrigable would be $\frac{25}{105} \times 2,918,817 = 1,392,477$ acres or 520,477 acres more than we can provide for after all our economies. This acreage represents a very large discharge indeed. Now I do not ask that the Eastern Canal be called upon to re-let its irrigation beyond what is found necessary on the Western Canal, but I think that, as far as possible, similar rules should be in force on both sides of the river. I am not acquainted with the country, on the Eastern bank of the river, but I see from the printed papers that practically one-half of the whole commanded area was irrigated on the average of the three years, 1897-1898 and 1899, and I therefore think it will be found on examination that many villages must irrigate, annually practically the whole of their cultivable area. If this be the case then I think it is evident that much water could be taken in the *rabi* from the Eastern and given to the Western Canal.

These canals are in two different Provinces and much will be said on both sides of the question, all I urge is that the matter be gone into as quickly as possible so as to secure perfectly equal treatment to the cultivators on both banks of the river, for the matter is one of vital importance to very large areas of periodically famine-stricken territory in the Panjab.

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APPENDIX A.

	Western Jumna Canal.	Eastern Jumna Canal.
1. Gross area commanded . . . Acres	2,732,112.	851,400
2. Culturable area commanded . . . "	2,114,847	621,825
3. Area irrigable by present project . . . "	870,500	335,000
4. Area irrigable at present . . . "	870,500	335,000
5. Average area irrigated in the 3 years, 1897-1898, 1898-1899, 1899-1900 . . . "	734,746	307,432
6. Percentage of cultivable commanded area which has been irrigated in three last years . . . "	31.3 per cent.	49.4 per cent.
7. Percentage of cultivable commanded area which present project can irrigate . . . "	40.6 per cent.	54 per cent.
8. Average duty of water in three last years . . . "	250	247

Note, dated 5th November 1901, by the Honourable Mr. Sidney Preston, C.E. Chief Engineer, Irrigation Branch, Punjab.

There is not much in this note which has not already been urged before the Commission by myself. Mr. Mullaly has, however, definitely formulated the proposal that the division of the cold weather supply of the Jumna between the Eastern and Western Jumna Canals, viz., one-third and two-thirds should be revised so as to give a larger share to the latter. This matter was mentioned at Lyallpur on the 2nd instant, but did not come directly into my evidence. Of course it would be advantageous to this Province, but I should have to study the facts in much greater detail before I could say it would be a right thing to do. Mr. Mullaly has not alluded to the North-Western Province Agra Canal, which also takes out of the Jumna and to which a portion of the North-Western Provinces share of the River discharge is passed on.

1. Q. (The President).—You are, I understand, Superintendent Engineer of the Western Jumna Canal?—Yes.

2. Q. How long have you been there?—Six months.

3. Q. Where were you before?—On the Sirhind Canal.

4. Q. Have you had any famine work to do?—No.

5. Q. You say alluding to the importance of reducing irrigation in the upper portions of the Western Jumna Canal "a large proportion of the commanded area in the Karnal and Delhi District has had too much water." How do you arrive at the figure 300 oases as the total saving from reducing irrigation; have you pretty sound grounds for it?—I called on the Executive Engineers to send me account of the amount of water that was saved on each distributary, I totalled them up and arrived at the figure given.

6. Q. How was the saving effected on the distributary?—The amount saved on the distributary is the sum of the savings on the outlets.

7. Q. Have they a fair idea of the discharge of each outlet?—Yes a very fair idea. A certain area of land has been put under each outlet, we know what each outlet will irrigate and if necessary reduce the size according to rules.

8. Q. As regard the orders of Government that over-irrigated portions of a village were to have the supply reduced and the saving thus effected given to under-irrigated parts of the village and not passed to the south, do you think it was a wise policy?—It is hardly for me to say, it was done under the orders of Government.

9. Q. How long has it been going on?—For 2½ or 3 years; it has just been completed.

10. Q. Can you give us some particulars of what was done?—I give an instance: A village had three outlets, according to its proper share it should have only had two; two were given to it, but part of the water of these two outlets was allotted for land that had not been already irrigated in the same village; the water was more fairly distributed while the total supply to each village was reduced.

11. Q. Do you think these measures have got to a stage of finality?—I don't think we can reduce much more.

12. Q. Has the area actually irrigated been reduced much?—I can not say; less water has been given to the old area; we are not in a position to say what the effect has been; this is practically the first year in which we have tried it.

13. Q. Have there been remonstrances from the people?—Yes.

14. Q. If you found at the end of two or three years that there was any diminution in the area of irrigation, would you advocate further measures?—The present arrangement should be allowed to stand for certainly 10 or 12 years.

15. Q. As an act of justice towards the people?—The seasons vary so much that we cannot be quite sure of the results; drought may come and perhaps the crops will not be quite up to the standard.

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16. Q. Have you gauges to show that by this reduction there is a distinct increase of water in the lower reaches of the canal?—Yes.

17. Q. You go on to propose "that certain tracts in the Delhi and Karnal Districts are over-irrigated and I am therefore submitting proposals for giving only one watering in the cold weather for crops which are grown in areas on which the subsoil water is 15 feet or less from the ground surface." Would you carry it out at once?—I propose in the upper parts, which are the worst, that we should carry it out from the beginning of the *rabi* next year, give them a year to prepare for the change.

18. Q. What would happen where there was a sugarcane village?—On the Bari-Doah the final watering is taken during November, we also then give the first watering for the *rabi*.

19. Q. Is it the same on the Western Jumna?—It should be.

20. Q. Would that be tantamount to closing the Western Jumna Canal altogether on the 1st of December?—No; the Delhi Branch except two large distributaries which go into dry areas.

21. Q. Don't you think that would cause a tremendous row?—Yes, certainly; there could not be a bigger row than there was in Gurgaon, but it was carried through.

22. Q. Did the Settlement Officers protest?—Mr. Dane was the Settlement Officer and he said that refusing all *rabi* supply after the first watering would work all right, if we gave them a greater area in the *kharif*. This has been done.

23. Q. You make a suggestion about the Eastern Jumna Canal, which we shall not forget?—I think my meaning has been a little misunderstood by the Chief Engineer in his note, I don't propose necessarily to alter the proportion in which the supply is distributed between the two canals, but I suggest that the officers of the N.-W. Provinces should cut off the *rabi* supply just as we do if the conditions are the same, and utilize the saving; if they cannot utilize it I would re-open the question of the shares of the two canals, and redistribute according to the wants of the localities.

24. Q. You don't think anything can be got out of the minor hill streams?—Not much; I have been taking out figures, the Chantang is doing all it can.

25. Q. What has been your habit about supplying village tanks with water; have you had many applications to give such supplies?—None last year on the Western Jumna Canal, but on the Sirhind Canal we devoted the whole of the water in April to filling up tanks, we could not keep pace with the demand.

26. Q. Did you charge anything for it?—No; it was all free.

27. Q. Practically any village that was situated so as to get water could get it?—Yes, in every village the drinking-water tanks were filled up.

28. Q. Were the villages bound to make water-courses from the distributary to the tank?—Yes.

29. Q. Were they very long?—In one case was quite four miles long, the villages made them themselves for the sake of getting water into their tanks. Several villages continued to do it.

30. Q. (Mr. Ibbotson).—Supposing a village did not irrigate from the canal, did you still give them the water?—Yes.

31. Q. (The President).—Have you had any experience of famine relief works?—No.

32. Q. You say you have reduced irrigation in Ludhiana on the upper reaches of the Sirhind Canal, where is that water going to?—We are sending it to Ferozepore.

33. Q. Is that part badly in want of water?—Yes.

34. Q. Are the wells deep?—Yes, 120 feet deep.

35. Q. Is the Sirhind Canal now doing much irrigation in that District?—(Mr. Wilson).—87 per cent. of the cultivatable area in the Fazilka Tahsil.

36. Q. (Mr. Higham).—In regard to the proposal originally submitted for closing the *rajbaha* during the *rabi*, you propose to close them from the 15th October?—Yes, then open again for ten days in November for the last cane and first *rabi* watering.

37. Q. Would it be possible to check the demand for *rabi* irrigation by raising the rates for sugarcane very high?—I don't think that would do, because Indian cane would be substituted and that requires a good deal of watering; I think it would take the place of sugarcane.

38. Q. Indian cane does not want water after October?—No doubt it would be an improvement, but I think you must go to the root of the matter and close the distributary altogether.

39. Q. Supposing you close the distributary altogether and force them to use wells for sugarcane after November, do you think that it would be right or necessary on that account to lower the present rates for cane?—No, the rate is very low as it is.

40. Q. Suppose you said we want to close the *rajbaha* during the *rabi* and in consideration of doing that we won't charge so much for cane as we have done hitherto; I am thinking of reconciling the people to the change; would it not be a fair bargain to say we are going to close the *rajbaha* as soon as the supply in the river falls; that is one alternative; the other is to raise the rates to a prohibitive pitch and discourage sowing sugarcane?—In the first place I don't think that this closing of the *rajbahs* will affect the area of cane at all—it has not affected it in the least in the Bari Doah.

41. Q. Do they want water for cane after November?—No Except in dry years.

42. Q. Do you think that they would have to sink any new wells in the cane villages?—If they were keen on extending the cultivation they might do it. I should say the best plan would be to offer them a larger amount of water for the *kharif* but not for cane which takes water at a time when it is wanted elsewhere.

43. Q. One result would be a complete closure of the Delhi Branch?—Yes, all except the Bahlot, the Rohtak and perhaps one other distributary.

44. Q. What about gardens?—If gardens are worth keeping up they should be kept up on wells; the water is close to the surface.

45. Q. It would drop?—Yes; no doubt, but not enough to make the wells unworkable.

46. Q. What about navigation?—It would make very little difference; the Branch is now closed for twenty days in every month.

47. Q. (Mr. Wilson).—All the year round?—No; in the *rabi*.

48. Q. (Mr. Higham).—Is the Haasi Branch closed for twenty days?—Yes.

49. Q. If you favoured any Branch it would be the Haasi Branch?—Yes.

50. Q. (President).—When do you begin that closure?—As soon as the water falls off.

51. Q. (Mr. Higham).—You estimate, you would save 1,300 cuasecs; your figure seems wrong, 1,300 is the full discharge of the Branch?—I have taken the full discharge.

52. Q. You say you only work the Delhi Branch ten days, therefore the actual supply would be one-third of 1,300, is that not so?—Yes, but the area added to the Haasi Branch would be the same as that now done on the Delhi Branch.

53. Q. You have also taken credit for 300 cuasecs by remodelling the outlets, are you not taking that twice over. You are going to take the whole of the water in the Branch?—The outlets are reduced.

54. Q. If you close the Branch it does not matter how much you reduce, you cannot take credit for that twice over. It seems to me you would only get this 300 cuasecs during the *kharif*?—Yes.

55. Q. In regard to the shares of the Jumna canals, it is supposed to be one-third to the Eastern Jumna, two-thirds to the Western Jumna, how is that distribution effected?—By tabular discharges at the heads.

56. Q. When were these made?—In the Western Jumna last April, I cannot speak of the other.

57. Q. Is the rule of equal gauges maintained?—No, the Dadopar Fall has been remodelled.

58. Q. Have you had a discussion with the North-Western Provinces and made any other rule?—Simply the discharge is taken.

59. Q. It is not on the basis of equal gauges?—No.

60. Q. Would it be possible to run fuller supplies on the Western Jumna during the time you can get it, than you run at present?—I think so, certainly.

61. Q. What is the maximum discharge?—6,400.

62. Q. That is since the opening of the Sirsa Branch?—Yes.

63. Q. What was it before that?—I cannot remember.
64. Q. Six thousand and four hundred is a very large amount compared with what they used to run; has the increase been accompanied by any increase of water-logging in the Unbhatta and Karnal districts?—There have been complaints, it is not worse now than before, we have drained a good deal.
65. Q. Has the capacity of the channel been increased?—Yes, greatly.
66. Q. Bends have been cut off?—Yes.
67. Q. That must have increased the slope?—Yes.
68. Q. How much have they increased the height of water level?—Up to 11'9, I think before it was 11½ feet, it must have been by about half a foot.
69. Q. Do you think you could put down much more water; there must be some limit as to what you could carry?—Probably up to 7,000 cusecs, that is quite a rough estimate, and the amount would be limited by the time of the year that that extra supply would be available in the river.
70. Q. During what months would you be able to get more water?—I should say from the 15th of June to the 25th of August.
71. Q. At present you take all the water you can get up to the 15th of June?—Yes.
72. Q. That is required for cane?—Yes, and extra *rabi*.
73. Q. (The President).—Have you a permanent weir across the Jumna?—Yes.
74. Q. (Mr. Higham).—When do they begin to take water for rice?—On the 15th of June.
75. Q. If you took extra water and sent it down into the Hissar district, you don't think you could give water before the end of June?—No.
76. Q. How long would it last do you think?—To the 25th of August or the 1st of September.
77. Q. They would not have much more than two months' supply?—I am talking about a dry year like the present.
78. Q. Would there be any demand for water for *chari* and *juar* in those months?—It would be very exceptional even in the dry tracts.
79. Q. Is there any diagram of the discharge of the Jumna?—Yes (diagram shown).
80. Q. As regards carrying down an extra supply, what is the country to which the extensions would be made?—(Map shown).
81. Q. Have the alignments of the channels been considered?—They are being surveyed now.
82. Q. Supposing you could decide on the possibility of running an extra supply, say 10,000 cusecs, would it not be as well to settle which way it should be taken and align all the channels?—Yes.
83. Q. Would it not be a good way of employing famine labour?—The larger ones would.
84. Q. I suppose if famine came on now, you would not be ready for it?—No. Not as I should wish. The extensions of the canal that I advocate would not be available.
85. Q. It has been suggested that you might fill the new tanks that have been made in the Hissar district; do you think that would be practicable?—I don't know where the tanks are.
86. Q. It would not take long to align the channels?—No; I should think that could be done.
87. Q. I think as a fact we may always rely on having large surplus supplies for a few days in the monsoon?—Yes.
88. Q. Even if you have none in dry years, good could be done by filling these tanks in the rains and making them water-tight?—I don't think you could get much silt into them.
89. Q. If you know where these tanks were, there would be no difficulty in getting out proposals for the channels?—None.
90. Q. That would not require much survey?—No.
91. Q. In regard to the various main drains, that have been made in Karnal, is there any advantage in further widening and enlarging them?—There is one new survey, it is reserved as a famine relief work (No. 8.)

92. Q. Are there any other drains going to be enlarged?—No—not at present.
93. Q. (Mr. Wilson).—A good deal has been done already to straighten and widen the channel of the Western Jumna Canal?—Yes.
94. Q. Is it desirable to make any more cuts-off?—Yes: one at Jagadhri.
95. Q. There is not much possibility of famine there?—No.
96. Q. It is not too far away from famine-stricken parts for people to go there?—We have been asked to keep it in hand.
97. Q. Would that work employ a large number of labourers?—Five hundred for six months.
98. Q. Are there any other such cuts-off?—I don't know the exact locality of any others, but could provide others.
99. Q. You said that you supply water free of charge to village tanks; the demand is much greater than you can supply?—On the Sirhind Canal only in certain months, April and May.
100. Q. You could have supplied the demand if you had stopped irrigation?—In April they did very little irrigation there.
101. Q. Is it the general principle that tanks should get filled before the demand for irrigation begins?—Yes on that canal.
102. Q. In the case of one watering in the cold weather do you propose to charge a lower rate for that one watering for the *rabi*?—Yes.
103. Q. A lower rate than the full *rabi* rate?—Yes.
104. Q. On the Bari Doab Canal you try to give a full watering for the *rabi*, if you have the water?—Yes.
105. Q. But you are not bound to do so?—No.
106. Q. Do you charge a full rate for the *rabi*?—I never did.
107. Q. Mr. Fanshawe, in the last paragraph of his second memorandum, says, "it cannot be right that in years of famine canal villages should be nearly as badly off as unirrigated villages, but this was the case I consider in a large number of cases in the Hissar and Rohtak districts in 1899 and 1900." Do you know anything about that?—No.
108. Q. Some officers say it is no use giving a watering unless the canal can guarantee ripening the *rabi* crops, can you give any such guarantee in the case of this dry tract?—Yes, I don't mean to say that the crop will be the same quality as a well crop, but we do not give water to land unless it is practically certain that we can guarantee a half outturn of grain plus three-fourths outturn of fodder.
109. Q. When you supply water for a tract, you give the village a certain amount of water, but you have no control over the area to which they give the water?—We have a village map and mark on that certain areas, which we can command, every man in that area has a right to the water, but only one-fourth of the area will get the water. If a man has ten acres, even if he is close to the canal, he can only irrigate 2½ acres; every man in that area has equal rights to the water up to a limit of 25 per cent.
110. Q. Is it not often the case that they sow a much larger area of *rabi* in the hope of getting rain?—Yes.
111. Q. If the rain fails you cannot give them enough canal water?—No.
112. Q. And the crop fails. In such a case do you charge full rates for the crop that has partially failed?—No; if it is less than one-half of the crop we remit. This was my rule as Executive Engineer on the Bari Doab Canal.
113. Q. Then the remissions must be very large in a year of drought?—Yes.
114. Q. Mr. Fanshawe, also says, "if we cannot forbid such crops [sugarcane and cotton] can we not at least arrange that in years of failure of rain canal water will be given to grain crops in preference," that is to say stopping water to sugarcane and cotton and give it to grain crops, would that work?—I don't see how you can refuse if they have started their crops on the supposition that you will give them water.
115. Q. Are not the initial expenses of sowing sugarcane pretty considerable?—Yes.
116. Q. You say on the Bari Doab Canal there was considerable discontent as regards closing in the *rabi*. What is the chief reason of the discontent?—They thought they would lose their sugarcane.

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117. Q. But experience shows that they did not?—Yes.
118. Q. The rainfall is fairly secure?—Yes.
119. Q. If a similar policy was followed in a tract where the rainfall is not secure, they would similarly fear they would lose their sugarcane?—Yes, until they got into the habit of sowing earlier so as to take the last watering with the *rabi* plow.
120. Q. You don't advocate this policy except where water is near the surface?—No, only where the depth is 15 feet or less.
121. Q. (Mr. Rajaratna.)—You spoke about the stoppage of irrigation in certain parts of Ludhiana by the closing of sluices; were not large areas deprived of irrigation by these means?—One crop; for the *kharij* they had the usual supply.
122. Q. The water saved in the *rabi* was given to other villages, I suppose?—Yes in dry tracts.
123. Q. These tracts don't want any supply for the *kharij*?—Yes, they require it all the year round.
124. Q. Why do you deprive one village of the benefit of *rabi* cultivation and give it to another?—In the upper tract where we reduce the supply the sub-soil water is within ten feet, in the other it is a hundred feet from the surface; in the former there is a lot of malaria on account of water-logging.
125. Q. (The President.)—I suppose the rainfall is far greater than the rainfall down in Ferozepore?—Yes.
126. Q. (Mr. Rajaratna.)—You said in reply to Mr. Wilson that you would stop the ryot from irrigating a larger area than that for which the water was available, how would you do that?—The other men would prevent him, not we.
127. Q. How do you regulate the supply?—We allow sufficient water to irrigate one-fourth of the area in the old villages. Before the new procedure came into force, some of them irrigated the whole of their areas.
128. Q. You limit the supply to one-fourth and they distribute it as they like; if owing to extended irrigation it goes beyond the limit, and there is a short crop why do you remit the assessment?—We do not go into that, we remit on failure of crops. This must be understood to refer to my personal procedure on the Bari Doab Canal.
129. Q. (Mr. Jebbetson.)—Were you not on the Western Jumna Canal in the old days?—No.
130. Q. You say that it is too soon yet to say what the restriction of irrigated area is, due to the reduction of supply which has been going on for the past two and a half to three years; but before that was there not a considerable reduction of the irrigated area in the water-logged tract of the Western Jumna Canal?—I think the actual irrigated area has increased.
131. Q. When the new main line was opened you obtained command of a large tract which was formerly irrigated by lifts and was not water-logged?—Yes.
132. Q. The lift irrigation had been practically confined to small tracts, and you now irrigate a considerable area that had not had water before?—Yes.
133. Q. Even supposing it is the case that the old canal villages have not reduced their irrigated area, is it not possible that the water-logged villages may have had their area reduced considerably?—It is possible.
134. Q. It is likely that there is a good deal of that?—Yes.
135. Q. There is now a proposal to reduce the area largely in addition to any reduction that may have then taken place?—Yes.
136. Q. As regards your proposal to refuse water to the *rabi* on the Delhi Branch, there is a large wheat and food crop area in the *rabi* along that Branch, is there not?—Yes; there is.
137. Q. I think in 1900, it suffered very much because you could not give it enough water to mature the crops?—Probably they considered it suffered very much, I think that is a comparative expression.
138. Q. Supposing you had given no water at all in 1900 what would have happened?—I cannot say.
139. Q. Would not the crops have gone absolutely?—The outturn would have been very much less.
140. Q. Would you have got anything?—Yes, I think so.
141. Q. How; I am speaking of 1900?—The *kharij* would be very large and well matured.—The *rabi* would have a first watering and probably a last watering; the outturn would probably be $\frac{1}{3}$ rd to $\frac{1}{2}$.
142. Q. But even in any year the outturn would be considerably reduced?—Possibly. I think probably.
143. Q. As a fact the people found it worth while to irrigate from their wells after the first watering at considerable expense to themselves, in order to get the increased produce?—Yes. Unfortunately the wells are very few in number.—It is part of my proposal to quite treble the number of wells.
144. Q. Even with that watering the total produce would be considerably diminished?—Yes.
145. Q. And you would diminish the produce every year, and reduce it to nothing in a famine year, in order to spare water for Hissar?—That is rather an extreme view. In Ludhiana, where the *rabi* rainfall is exactly the same as in Delhi, they had fair crops.
146. Q. There, is the rainfall liable to fail the same as in Delhi?—Yes.
147. Q. What would happen when the rainfall did fail?—It cannot yet be said.
148. Q. I don't quite understand about the one-fourth area; supposing a man has ten acres and you gave him water for two and a half acres, say his turn is six hours, and he decides not to put the full amount of water on the two and a half acres, but to distribute it over a larger area, you don't stop him when he has watered his two and a half?—No, we cannot stop him.
149. Q. As long as he did not exceed his six hours even the villagers would not interfere with him?—No.
150. Q. You say if there is less than half a crop, there is a remission; Mr. Preston said that if there is no crop there is no charge, but that any crop at all, that can be recognized as a crop, would pay the full rates because you could not trust the establishment to estimate how much the crop fell short?—I think the rule differs on different canals.
151. Q. On the Western Jumna Canal what would a one-fourth crop pay?—I remit three-fourths of the assessment.
152. Q. Half a crop would pay half rates?—Half a crop or more would pay full rates; less than half a crop would receive proportionate remission.
- This only refers to the Bari Doab and Western Jumna Canals.
153. Q. (The President.)—On the old Western Jumna Canal there must be a number of old loops at the bend of the canal?—Yes, we have cut them off.
154. Q. And are the old banks still standing?—In many cases they have been restored to cultivation.
155. Q. Would that be a good famine work, to give it back to cultivation again?—I don't think so.
156. Q. (Mr. Higham.)—Can you say anything about the prohibition of rice cultivation in the Hissar district?—Yes, there was an order by the Deputy Commissioner forbidding the cultivation of rice. When that order was given there were 10,000 acres in the Hissar Division of the Hansi Branch, in the next year there was absolutely none, and from that time it has again gone on increasing till the last return was about 3,000 acres.
157. Q. They have been growing it again? Why? Is that due to laxity?—The order has not been enforced.
158. Q. Is there any rule under the Act by which you could enforce the order?—I am not aware of any.

WITNESS No. 32.—MR. C. M. KING, I.C.S., Settlement Collector, Ferozepore District, Sindh.

Memorandum on Irrigation Inundation Canals in the Ferozepore District.

Mr. C. M.
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The Ferozepore Inundation Canals were started by Colonel Grey, C.S.I., when he was Deputy Commissioner of Ferozepore in the seventies. Some of the canals are the

property of the *adncshes* (irrigators) and some the property of the Nawab of Mamdot. All the canals are managed by a local (district) canal department, at the head of

which is Rai Bahadur Maya Das, Extra Assistant Commissioner. These canals irrigate the Hihhar or low lands of the district, while the Sirhind Canal irrigates the Rohi or uplands. At present there is a small strip of country between the area commanded by the Sirhind Canal and that commanded by the existing inundation canals. About 3½ years ago, when I was Deputy Commissioner of Ferozepore, I had this strip of country surveyed, and a new canal aligned. This new canal was to have its head in the Ludhiana district just outside the Ferozepore district, and would have irrigated most of the dry villages in the Moga tahsil between the Sirhind Canal and the existing inundation canals. The initial cost of the canal was to be met by a loan of over a lakh of rupees from the Mamdot Estate, the loan being repaid by the imposition of a small rate per acre irrigated. According to my calculations the whole loan would have been repaid with interest at the rate of 6 per cent, before the present Nawab came of age. About that time also the existing settlement of the Moga tahsil would have expired and the rate could have been converted into a fluctuating land-revenue rate payable to Government. The Local Government did not at the time approve of the scheme, partly because it would be necessary to obtain a loan from the Mamdot Estate. I understand that the scheme is now being elaborated, and that there is every chance of the canal being constructed. I am told that among the schemes to irrigate the Montgomery bar is one to construct a dam across the Sutlej just above the railway bridge and to take off a perennial canal from above this dam. The effect of this dam must be to lower the head of water below it, and unless something is done to compensate the *abstraction* of the inundation canals having their heads below the dam, they will suffer a serious injustice. I talked over this matter once with Mr. Perford, at that time Chief Engineer. He thought that in the first place the head of water in the river below the dam would not be lowered, by the dam, and in the second place, if it were lowered, that the existing inundation canals need only be deepened and extended. If the head of water below the dam is not lowered, no harm will be done, but if it is lowered, then the mere fact that the canals can be deepened and prolonged will not do away with the injustice done to irrigators whose lands now receive water, but whose lands will be left high and dry if the canals are extended. Other people will benefit no doubt, but the benefit done to them will not make good the harm done to the others. Mr. Perford then suggested a third plan which was that a feeder canal should be constructed having its head above the dam and running along the river and giving water to all the Ferozepore inundation canals below the dam as well as to the inundation canals of the Unahawalpur State. If this plan is feasible it will certainly improve all the inundation canals at present existing. The canals above the dam or weir will be improved in any case as the weir will raise the water level and thus the canals ought to begin running earlier and continue running longer than if the weir is not constructed. I think a feeder canal would have the same effect on the canals below the weir.

2. The Ghaggar Canals in the Hissar district are the outcome of the famine of 1896-97. It is true that the project for these canals had been considered long before

that year, but the famine led to the project being hurried on, and the canals were constructed with famine labour. These canals have hitherto not been as successful as it was hoped they would be. This is owing to the exceptional character of the seasons since the canals were dug and partly to the apathy of the people, who are for the most part unable or unwilling to construct the necessary water-courses. This apathy is particularly noticeable in the case of the country round Ellenabad which has been deprived of flooding from the Ghaggar by the Southern Canal. The Canal Department has constructed a *rajbaha* for the people, but this does hardly any irrigation, because the people have not constructed any water-courses. I think that the more lengthily of these water-courses might be constructed at the expense of the Canal Department, though it is hard on that department to bear the expense, as at present it is getting no return for the construction of these canals, nor have the canals tended to any material degree to protect the tahsil against famine.

3. With the exception of the area irrigated by the Ghaggar canals and of a very small area irrigated by the Sirhind Canal in the Rohi Circle, and another small area irrigated by the Western Jumna Canal in the Bagar Circle, the whole of the Sirsa tahsil is entirely dependent on the local rainfall, which is very precarious. The depth of water across the tahsil is far too great to admit of well irrigation. In the Bagar Circle the depth of water is about 150 feet, and in the Rohi Circle it is about 120. Close to the Ghaggar Stream a little well irrigation is possible, but this well irrigation in many cases is unnecessary as the area irrigated by wells can equally well be irrigated by direct flooding from the River Ghaggar or by the Ghaggar Canals. An attempt was made a few years ago to extend canal irrigation to the Bagar Circle, but the canals and water-courses were so frequently blocked with sand that the attempt had to be abandoned. Throughout the Bagar and Rohi Circles the people are greatly dependent on their ponds for drinking water. These ponds are usually too small to contain water right through the dry season; this year, which is a very bad year for the tract, most of the ponds are already quite dry, and in many cases the people have to go 6 or 7 miles for water. I think that in a few selected villages these ponds might be enlarged and greatly improved. The difficulty in a place like Sirsa is always the want of water for drinking purposes, and if this difficulty can be lessened, it will be a great boon to the district. I do not advocate the extension of canal irrigation in the Bagar Circle, but I think that some extension might take place in the Rohi Circle, a small portion of which is now watered by the Sirhind Canal. I do not know if there is sufficient water in the river at Rupar to permit of more water being sent down this canal in the winter, but there must be plenty of water in the summer, and if irrigation is extended to the Rohi Circle only in the summer months, it will be a great boon.

4. I have often thought that this was a district in which artesian wells might with great advantage be constructed. I have read that artesian wells have been constructed and used for irrigation in the drier parts of Queensland, and this has led me to think they might prove useful in Sirsa; but I know nothing about artesian wells, and I merely throw out this suggestion.

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1. Q. (The President.)—You are Settlement Collector of Sirsa?—Yes, I have also some special duty in the Ferozepore district, in connection with the revision of the *abidani* rates on the Sirhind Canal.

2. Q.—You allude to a canal you yourself had had surveyed in the Ludhiana district; has it ever been made?—Not yet, but I believe it is to be made soon.

3. Q.—When did you leave Ferozepore?—I was there as Deputy Commissioner in 1900; nearly all my work has been in the Ferozepore district.

4. Q.—Did you find that much alarm was felt about the proposed new Lower Bari Doab Canal?—No, I don't think so—the officials were more alarmed than the people.

5. Q.—You say, in paragraph 2, of the Ghaggar Canals—"These canals have hitherto not been as successful as it was hoped they would be; this is owing to the exceptional character of the seasons since the canals were dug, and partly to the apathy of the people." I suppose they were rather intended for exceptional seasons?—I believe that was the original idea; they were dug for flood water; in a dry year there is no water in the Ghaggar at all. One year they had a great flood, more than the canals could hold, then in a dry year there was not enough water to irrigate.

6. Q.—You would not pronounce them works of any value for famine protection?—They would afford protection to a small extent; they are not of very great value as famine protection.

7. Q.—As regards the Sirsa tahsil, have you any suggestion to make to protect that from famine?—The only suggestion I have to make is that you might get more water from the Kotla branch of the Sirhind Canal, that would protect the north-west part of the tahsil; and you might extend the Western Jumna Canal branch; that has been attempted before, but for some reason they stopped irrigation except in one particular circle—the Nali.

8. Q. (Mr. Higham.)—What has been attempted before?—Extension from the Western Jumna into the Bagar Circle.

9. Q.—You say in paragraph 3, "the depth of water all over the tahsil is far too great to admit of well irrigation. In the Bagar Circle the depth of water is about 150 feet and the Rohi Circle it is about 120." These wells although out of the question for irrigation are suitable enough, I suppose, for drinking?—No, in most cases the water is very bitter; a good rainfall will make the water sweet; it is generally quite undrinkable.

10. Q.—Have you had any famine experience?—No.

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11. Q.—As Deputy Commissioner of Ferozepore you had only very slight charge of that system of canals that Colonel Grey began?—I was responsible for them entirely. Maya Das was my executive officer.

12. Q.—I suppose they are now running very smoothly?—Yes.

13. Q.—Does the Deputy Commissioner exert any control?—It is merely nominal.

14. Q.—Maya Das is rather an exceptional man, I believe?—Quite exceptional.

15. Q.—Do you think that having got a start one may now look forward to the canal going on without more interference?—Yes.

16. Q.—I suppose you highly approve of the system?—Yes.

17. Q.—Could it be introduced elsewhere do you think?—The only place where I think it might be introduced is on the Inundation Canals in Montgomerie.

18. Q.—Have you had any experience of private canals elsewhere?—No.

19. Q.—Do you think the District Board could work a system of Inundation Canals?—The District Board is practically the Deputy Commissioner.

20. Q.—You draw our attention to the question of artesian wells?—Yes, I heard of their being tried in Bhivani, but they did not prove successful.

21. Q. (Mr. Wilson).—They went down to 1,300 feet.

22. Q. (Mr. Higham).—You say in your note that "the Ghaggar Canals are not as successful as it was hoped they would be; this is owing to the exceptional character of the seasons since the canals were dug, and partly to the apathy of the people, who are for the most part unable or unwilling to construct the necessary water-courses."?—Yes, they were also partly holding off because they are afraid of getting their assessment increased.

23. Q. How do they have cultivation at all?—They have got none.

24. Q. They cannot keep that on for ever?—They have done it for two years; the land is for the most part owned by banias, who can afford to wait.

25. Q. Would not making water-courses be a good relief work?—Yes, if you had a famine.

26. Q. You spoke about filling tanks from canals, do you know those villages that are south of Dabwali?—Yes, there are some filled from the Kotla branch.

27. Q. As regards the Dabwali, that was made mainly with the intention of filling village tanks; the witness we have just had said one village was four miles distant; do you know anything of these villages or of the arrangements that were made?—No.

28. Q. You don't know much of these villages that fill their tanks from the tails of the Sirhind Canal?—No.

29. Q. (Mr. Wilson).—About this question of filling village tanks from the Sirhind Canal, is it usual in the Fazilka tahsil for village tanks to be filled from a canal?—Yes.

30. Q. Nothing is charged?—No, if water is taken just before the canal closes for silt clearance.

31. Q. Is something charged at other times?—Yes, full rates.

32. Q. Is it a generous policy to charge them for filling their tanks at any time of the year, if you have surplus water?—I have never heard complaints about drinking water in the Fazilka tahsil.

33. Q. Are you quite sure about the charge for drinking water?—Yes; if the water is taken.

34. Q. Is not drinking water so valuable that it might well be given free for the villagers and their cattle?—It is not so valuable in Fazilka as it is in Sirsa, because the people can use the water in the canals.

35. Q. The water in wells in Fazilka was formerly very brackish and the effect of the canal has been to make the water sweet?—Yes.

36. Q. And the canal has improved the condition of the tract?—Yes.

37. Q. Are there not some villages on the Sirhind Canal where the water is brackish and the wells and tanks could be filled from canals with sweet water for drinking purposes?—Yes, in the Dabwali tahsil.

38. Q. Would it not be good policy wherever such villages exist to provide them with drinking water and pour canal water into their wells even at the cost of irrigation?—Yes, I think it would be.

38. Q. In the Fazilka tahsil is it not the case that there has been a restriction of canal irrigation in the last 2 or 3 years?—Yes, there has been a restriction; the outlet pipes are now of smaller diameter.

39. Q. The effect has been to give them less water than before?—Yes.

40. Q. Has there been any great reduction of irrigation in consequence of this restriction?—No.

41. Q. Has any hardship been caused to the people in consequence?—There are great complaints, but I think it is due to their not having got sufficient notice, they continued to irrigate a large area and could not mature it.

42. Q. Do you think when they understood the matter that there will be any great hardship?—I don't think the water in Fazilka as a whole should be reduced.

43. Q. I am talking about individual villages?—I think if there is a village that gets more than its share there is no reason why it should not be reduced.

44. Q. Will it give rise to hardship?—No.

45. Q. What is done with the water saved?—They have tried to distribute it over the whole tahsil.

46. Q. Do you think that is a fair and proper policy?—I think so.

47. Q. In the case of the canal in Ferozepore you had a survey made—who made the survey?—I think it was done by the Canal Department.

48. Q. What sort of man was in charge of the survey?—A Sub-Overseer.

49. Q. On what pay?—Rs. 25 to Rs. 30.

51. Q. Were you satisfied with the levels made?—Mr. Mullaly went over it at my request; he was satisfied.

52. Q. Did he help you in designing the canal?—No, he said the canal had been very well designed.

53. Q. Was it designed by one of Maya Das's men?—Yes.

54. Q. What was the estimate of the probable financial result?—I proposed to borrow the money from the Maudslayi estate. I think it was to cost Rs. 1,25,000. I proposed to repay the loan by a vote on the acreage irrigated.

55. Q. Why could not the loan be got from Government?—I don't think Government could have lent us the money, and besides the money was lying in the Maudslayi estate; it was an excellent speculation.

56. Q. The result of such a canal would be that the land revenue assessment would be largely increased?—Yes, an extra Rs. 30,000.

57. Q. Should Government pay some part of the cost of this canal?—Government would not have spent a fraction on it. Government has not constructed any of the other canals in the district.

58. Q. Suppose Government said we were prepared to make these canals ourselves and charge occupier's rates, would that be better than the Ferozepore system?—No, I don't think so.

59. Q. What is the advantage of the Ferozepore system?—I would not propose two systems in Ferozepore, and it would cost much more; it is doubtful if Government could have done it as cheaply as it was done, as Government would have had to pay for the land: we got it for nothing.

60. Q. Who pays for the bridges?—They were paid for out of the silt clearance fund: there is a surplus.

61. Q. How did the surplus arise?—It is a sort of Joint Stock Company; the irrigators are called together, the acreage share is made up and the debt is made over that, enough to pay for the whole establishment and the clearance of the canal; in the clearance rate is included the up-keep of the bridges and new bridges.

62. Q. Are there masonry regulators at the heads of the canals?—No.

63. Q. Would it improve their working if they had masonry regulators?—Yes.

64. Q. Would it be difficult to raise money for such regulators?—No.

65. Q. Are the people willing to pay for them?—Yes, it goes into the silt clearance rate.

66. Q. (Mr. Ibbetson).—In the case of those villages in the Fazilka tahsil where the supply has been reduced and no hardship experienced, of what standing is the irrigation?

—It averages 12 years.

67. Q. How long have you been in Ferozepore?—Since 1896, my whole service being 9 years.

Mr. C. M.
King.

WITNESS 33.—MR. B. G. WALLIS, Superintending Engineer, 2nd Circle, Punjab.

Note on proposed Famine Relief Works in the various Districts in the 2nd Circle, Punjab.

1. The works have been specially considered in consultation with the Deputy Commissioners of the districts concerned and with the Commissioner and Superintendent, Delhi Division.

Note by Witness on proposed and existing bunds in the Gurgaon District.

1. In Appendix 10, attached to this report, figures are given showing the expenditure and income on seventeen of the chief bunds in the Gurgaon district during the last five years. From these figures it is found that considering the bunds collectively, (i) the average annual cost of maintenance is 1·4 per cent. on the original outlay, while (ii) the net profit averages 1·06 per cent. per annum on original outlay.

2. With regard to the cost of maintenance apparently the expenditure under this head has been cut down by the District Board to the smallest possible amount; little or nothing has been done in the way of annual repairs; the only repairs attended to have apparently been those necessitated by breaches of the bunds. Nothing has ever been done in the way of silt clearance inside the bund.

3. The net profit on the bunds would probably show a better return on the outlay in years of normal rainfall. It should be remembered that the years covered by the figures, were years of drought and in one case of famine.

4. The average annual cost of maintenance as deduced from Appendix 10, being therefore for the reasons given above, too small, the following detailed calculations may enable us to arrive at a more accurate estimate. Take the case of the proposed *Bhond Bund*.

Length of bund	.	.	= 3,050 feet.
Average height	.	.	= 28·16 " (say 28')
Top width	.	.	= 10 "
Side slopes	.	.	= 1 in 3 and 1 in 4.
Total earthwork	.	.	= 64,42,115 c. feet.

Cost of annual maintenance.

	Rs.
(1) Chowkidar one at Rs. 7 per month for 12 months	84
(2) Tools and plant (say)	16
(3) Earthwork, 1" on slopes and 3" on top = 68,459 c. ft. at Rs. 5 per 1,000	292
(4) Turfing slopes with grass	50
(5) Annual silt clearance say 100' wide, of 1" deposit along the whole length of the bund = 26,417 c. ft. at 5 per 1,000	125
TOTAL	567

Now the estimated cost of the bund is Rs. 39,067.

∴ the annual cost of maintenance may be put down at Rs. 1·8 per cent. on capital cost. The expected revenue from the bund is Rs. 1,481. Net profit therefore = Rs. 914 on outlay of Rs. 38,067 or 2·4 per cent. per annum.

5. The above estimate of the cost of maintenance it will be seen includes the item of silt clearance. Now in the case of most of the bunds already constructed, the silt brought down during the first few years after construction of the bund, only tends to raise the bed of the nullahs. These latter in many cases vary in depth from 10 to 15 feet, and the silt deposit in this confined limit may be put down as 1 foot a year in depth. When once the nullahs have silted up completely, the deposit spread out along the whole length of the bund and concentrated at the toe of the embankment may be set down at from 1 to 3 inches a year, the latter being a very liberal estimate. It should be remembered, when considering the question of silt clearance, that the value of the land increases proportionately with the deposit of silt on it.

6. Although in many instances in the past, the villagers have given the land on which bunds have been built, free of cost, compensation may have to be paid on account of the bunds now proposed. No provision has been made in the rough estimates on account of "compensation." The value of the land to be acquired may be set down as Rs. 30 per acre.

7. Apparently it is advisable that the Government should have absolute control over the water, in the case of bunds intended for perennial irrigation. To ensure this the whole of the area likely to be submerged should be acquired by Government. This should be done before the construction of the bund is put in hand, as the value of land will be greatly increased on the completion of the bund.

8. Of the bunds which it is now proposed to construct, the following are intended for perennial irrigation:—

Damdama.

Bhond.

Ghata Shamsabad.

Khanpur Ghati.

The remaining bunds, viz.:—

Dingoch.

Nandha.

Ghata Shamsabad.

Sikandarpur.

Gurgaon bunds

Nub

Tarna

Roheri

Sabras.

} Already constructed

will hold up water only during the rains, say from June to October. It should be noted that there are at present no bunds for perennial irrigation in the Gurgaon district. The existing bunds in years of normal rainfall only ensure the safety of the rabi crop. The land inside the bund obviously cannot be cultivated for the kharif.

9. This question has been considered fully in the reports accompanying the various projects.

10. Personal inspection and enquiries on the spot, showed that in the case of Ghata Bund, the land both inside and outside the bund is cultivated. From the land on the downstream side of the bund two crops are obtained, the water impounded by the bund being made available for irrigation in time for the rabi crop; the kharif crop on these lands depends entirely on the rainfall. The submerged area within the bund obviously cannot be cultivated for the kharif, but the reservoir can be emptied in time to allow of cultivation for the rabi.

11. The Bhadsinhpur bund differs in certain essential respects from the Ghata bund. The manner in which the impounded water is controlled is fully explained in Mr. McGregor's note accompanying the estimate. Here except in what may be described as the original basin of the bund, two crops a year are obtained, generally from all land both inside and outside the bund. The rabi or winter crop is generally, however, the better crop of the two.

12. Schemes for the construction of the following bunds have been investigated more or less in detail:—

Damdama bund

Dingoch "

Sikandarpur "

Nandha "

Bhond "

Ghata Shamsabad bund;

while schemes for the extension and improvement of the following have also been put forward:—

Roheri bund

Sabras "

Tarna "

13. Before proceeding to furnish the information called for by the Government of India with respect to these schemes, a few preliminary remarks regarding the nature

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and functions of these bunds might be useful. None of the existing bunds in the Gurgaon district provide for irrigation throughout the year. Water is impounded by the bunds during the rains,—say, from June to October. At the end of that period, the reservoirs are emptied so as to allow—

- i. of the submerged area on the upstream side of the bund being cultivated.
- ii. of irrigation by flow on the downstream side of the bund.

14. Now owing to the shallowness of many of the reservoirs, the net amount of water available for irrigation by flow, is small; so the utility of the bunds consists chiefly in improving the area covered by the water by means of deposit and soaking, also in recouping the sub-soil water and thereby assisting the well to supply more water.

15. With regard to the utility of the bunds considered as schemes for the utilization of famine labour, it should be noted that in normal years of rainfall the country is no doubt, benefited by them, while in years of scant rainfall they may still help in the protection of crops. If then, working expenses are paid in normal periods, the schemes might be accepted as financially sound with regard to the country as a whole, although in themselves far from being remunerative. Each successive famine would thus permanently enrich the country at the expense incurred during and immediately subsequent to the famine.

16. To consider now in detail the points on which information has been called for by the Government of India.

(a) When and by whom were the original proposals for the construction of the bunds put forward? Apparently proposals for the construction of the bunds enumerated above were first put forward by Mr. Roberts, late Deputy Commissioner, and Mr. Daniell, late District Engineer of Gurgaon, in 1852.

Detailed surveys have been made and plans and preliminary estimates have in each case been prepared for those projects which have not been carried out up to date. The quantity of water that will be available for irrigation, for the several bunds, is given in the following statements:—

Millieu.

Damdama bund	. . .	176½ c. ft.
Dingochia "	. . .	156 "
Sikandarpar "	. . .	72 "
Nandho "	. . .	153½ "
Rhood "	. . .	111½ "
Ghato Shamsabad "	. . .	78 "
Roheri bund "	. . .	97½ "
Sobras "	. . .	33 "
Taoru "	. . .	120 "

These quantities really represent the capacity of the various reservoirs, the whole of which will be available for irrigation by flow below the bund, after deducting the usual percentages for absorption and evaporation. As regards seasons of drought, there are no data available on which a reliable estimate can be framed. Even in good years, the rainfall is often erratic, falling on the catchment basin irregularly over small areas. Again the rain might fall in light showers, and at other times in heavy downpours amounting to as much as three inches in the hour. In years of drought the reservoirs would be practically empty and no revenue would be secured to Government.

17. The estimated acreage that can be irrigated annually is as follows:—

Damdama bund	. . .	12,165 acres.
Dingochia "	. . .	7,162 "
Sikandarpar "	. . .	800 "
Nandho "	. . .	5,290 "
Rhood "	. . .	1,861 "
Ghato Shamsabad "	. . .	2,700 "
Roheri bund "	. . .	860 "
Sobras "	. . .	1,137 "
Taoru "	. . .	4,132 "

The rainfall returns of the Civil Department for the last 10 years over the whole of the Gurgaon District, have been considered in forming estimates of the amount of water that would be available.

18. There has been famine or scarcity during the following years:—

1868-1869,
1877-1878,
1896-1897,
1899-1900.

19. No exact information can be furnished as to the maximum area that the proposed works will irrigate in a year of drought. During such seasons it is probable that there will be very little water available for irrigation by flow.

There is no danger of irrigation injuring the soil or resulting in water-logging in wet years.

20. A water-rate will be levied on the area irrigated.

21. Detailed estimates have been furnished for each of the projects.

22. All earthwork and rock-cutting could be carried out by famine labour and these two items comprise nearly all the work that would be necessary.

1. Q. (The President.)—I understand you are Superintending Engineer of the 2nd Circle in the Punjab?—Yes.

2. Q. How long have you held that appointment?—Since July 1900.

3. Q. What does the circle comprise?—The Civil Districts of—

Hoshiarpur,
Ludhiana,
Ambohra,
Karnal,
Delhi,
Gurgaon,
Rohtak,
Hisar,
Simla,
Kangra, including Kulu and Lahaul.

4. Q. Were you here during the famine?—The second circle was divided temporarily into—

- i. Famine circle.
- ii. Ordinary "

I held charge of the latter and afterwards of the former when it was re-amalgamated with the ordinary circle on the closure of famine operations.

5. Q. Have you had any famine relief work under you?—No, except a small one in Lahore.

6. Q. This programme of relief works, how is it prepared?—The ordinary annual programmes for Famine Relief Works are prepared by the Executive Engineers of ordinary divisions, in consultation with Deputy Commissioners. The programmes are then examined by me in consultation with the Commissioner and Superintendent of

the Civil Division and are then forwarded by the latter officer to the Local Government. The special programme of which I have sent you a copy, has been prepared in my Office, after collecting information from Civil Officers, Famine reports, etc. This is a very special programme, and has not as yet been submitted officially to the Local Government, as the appendices are not yet complete.

7. Q. It is supposed to be revised yearly?—The ordinary programmes for famine work are revised yearly. I presume the special programme which I have now prepared, will supersede the ordinary annual ones and it will be revised yearly.

8. Q. With reference to what you say in paragraphs 7 and 8 of your note have you seen any of these tanks?—Yes.

9. Q. Is there water in them to any extent?—There was not when I saw them last month.

10. Q. Were any connected with canal distributaries?—Yes.

11. Q. A good deal of work has been done in digging village tanks, do you think it is of any use?—Not as far as I have seen; eventually of course they will hold water better; so far it has been of no use.

12. Q. In working out this programme of works do you take into calculation the number of the population that had been employed during the last famine? How did you arrive at the number for which provision was required to be made?—I asked the Commissioner for the information as to the percentage of the people what would require relief.

13. Q. Would it not be better to try and find out what numbers were actually employed in the last?—I have

been trying to get that information; I think it has just come in.

14. Q. It is an important feature, is it not?—Yes.

15. Q. In some cases there will be more and in some less?—Yes, it greatly depends on whether we have to feed the people in their own districts or draft them elsewhere; in Rohtak we have projects for 6 lakhs of rupees; I think the idea is to draft people off from there.

16. Q. (Mr. Higham.)—The tanks in Gurgaon yield a return of 1 per cent.?—Yes, according to the statistics given to me.

17. Q. You don't know if the statistics are reliable?—They have been got from the Deputy Commissioner of Gurgaon.

18. Q. Have you taken the actual original cost of the bunds?—Yes, as far as I was able to do so, from the in-

formation supplied by the Deputy Commissioner of Gur-*Mr. Wallis.*
gaon. Please see Appendix 10 of my printed note.

19. Q. Have you made any allowance for a certain amount of land depending on the existence of these bunds, lands that are prevented from being submerged?—Only for the land irrigated.

20. Q. Not for protected lands?—That is a question that would require a lot of research.

21. Q. Why are the tanks dry?—They won't hold water because the soil is bad in some places and they have not had time to puddle themselves.

22. Q. Are they fed from canals?—Very few, I believe, can be filled from canals. I have seen two in the Hissar district, which can be so fed and these won't hold water.

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WITNESS No. 34.—MR. J. T. FARRANT, RESIDENT ENGINEER, PATIALA.

Memoranda by Witness.

I.—On Famine Protective Schemes in the Patiala State.

The Patiala Darbar have been asked by the Government whether they wish to have any schemes that they may devise for affording protection against drought included within the scope of the inquiry contemplated by the Government of India. This inquiry will deal with the subjects of famine works and programmes and the extension of protective irrigation.

2. There are several small tracts in the plains that require to be considered in connection with this subject of famine protection; but of these there are only two for which co-operation may be expected (and could be asked) from the Government. These are (a) the Narnaul tract and (b) the portion of the Narwana taluk that is situated east of the Ghaggar River and adjoins the Sirsa Branch irrigation. The other portions are small and isolated and could only be dealt with locally.

3. With regard to the Narnaul tract, it is evident from an examination of the map that any schemes for irrigation from a canal would have to form part of a project for the irrigation of the adjacent districts of Rohtak and Gurgaon. Such a project would have to be on a considerable scale, and would either consist of an extension of the existing Western Jumna Canal (which is improbable, or of a new canal from the Jumna river taking out above Delhi. As to whether such a scheme is possible having regard to the physical features of the country it is not possible to say here; but any such canal could only hope for a supply of water during the flood season, as there are already three canals fed from the Jumna—the Eastern and Western Jumna at Dalupur, and the Agra canal with its head-works at Okla below Delhi. It is evident then that any scheme for the protection of this tract by a monsoon canal would have to form part and parcel of a much larger scheme to be carried out by the British Government. Nothing has been said about irrigation from tanks and wells, because these are after all only minor works in which the only assistance required of the Government would be in the matter of professional advice perhaps. Something will be mentioned further on regarding storage tanks and wells.

4. The only other matter requiring reference to the Government with a view to assistance is the possibility or otherwise of extending the irrigation of the Sirsa Branch to the tract of land lying between the northern boundary of the present irrigation and the Ghaggar river. There is also a small tract lying between the southern irrigation boundary and the boundary of the Hind State which is unprotected so far and to which it may be possible to extend the irrigation.

5. Besides the tract of Patiala territory referred to in the two preceding paragraphs there are other small patches which feel the pinch of famine, but they are situated close to canal-irrigated country and are not in such urgent need for works of amelioration. At any rate such works would be local and such as would not depend upon the co-operation of the Government for their execution.

6. There is first the Sardulgarh tract situated on the left bank of the Ghaggar river, which thus cuts it off from irrigation by the Sirhind canal. It is doubtful whether any irrigation could be done from wells except in the immediate neighbourhood of the Ghaggar, as the spring level is

probably too low. This is, however, a matter for enquiry. Further, any project for damming up the Ghaggar and storing water, besides being very costly, would meet with disapproval from the Government and would raise thorny questions regarding the rights of the villagers lower down, especially as canals have been taken out of this river near Sirsa. Then again the Ghaggar here runs in a fairly deep channel and the greater portion of the water dammed up would be useless for irrigation as it could not command the country. The cost of a bye-wash to pass flood waters would alone be a very costly item. The best way to irrigate this tract, if the levels permit, is to carry the water of the Beha Rajbaha across in an iron tube siphon; if the levels permit this will be not only much less costly than any scheme for storage, but a perfectly sure preventive of famine, which a storage tank would not be.

7. The next tract is that situated between the Ghaggar River and the irrigation boundary of the Ghaggar and Choa Branches of the Sirhind Canal. This is liable to inundation not only from the Ghaggar River itself but from the Choa Nullah—sparsely populated and so close to irrigated country that it can never feel the pinch of famine very severely. Water for cattle can be had at no great distance—a very great advantage. Extensions could be made from the Karamgarh Rajbaha into a portion of this tract, but no irrigation would be done in years of good flood, and the channels would be liable to be damaged. The circumstances are not so urgent as in the preceding case; and extensions of the canal system would have to be cautiously made.

8. For the country on the left bank of the Ghaggar and situated between it and the Sirsa Branch, if nothing can be done from the Sirsa Branch Canal as suggested in paragraph 4 above, it is possible that it may be supplied with water from the Karamgarh Rajbaha, but levels would require to be taken. Even if the levels are favourable the scheme would be costly and would only be taken up after careful study of the whole question. Much might be done in the meantime to ameliorate the condition of the people by improving village tanks, taking care that there is sufficient catchment area for each.

9. The area near Patiala City and lying between the Patiala Nullah and the Ghaggar is irrigated partly from the Banur Canal and partly from cuts made from the Ghaggar. The wells are not deep either and the country is safe. But the condition might be improved by improving the Banur Canal alignment and taking the canal on to the watershed instead of passing it into the drainage line as has been done below Banur. The canal could then serve more country.

10. To return now to Narnaul. If this cannot be irrigated by a canal from the Jumna, either direct or from an extension of the Western Jumna Canal, recourse must be had to wells, wherever these are possible under the conditions, or storage tanks. This cannot be undertaken without careful surveys and unless the conditions are favourable. These conditions are dealt with in the accompanying short note on storage tanks. It is probable that in the near future artesian wells will be tried for such tracts as this, but they will be costly, are always more or less speculative in character, and unless experts are employed in sinking them the result is sure to be disastrous.

11. To touch on some other points mentioned in Khalifa Sayad Muhammad Hussain's notes. Nothing can be done with the Sirhind and Choa Nullah except perhaps improve their outfall and make them more effective as natural

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drainages. The country traversed by them below the Feeder Line at any rate is already irrigated by canals, and they are occasionally called upon to act as escapes for the canal. With regard to the Sursati, correspondence is already pending with the Government on the subject, and nothing further need be said here. Irrigation in the hills is already carried on extensively by means of ingeniously devised "kuls," and any system of pipe irrigation is altogether too costly to be thought of until the demand for it is shown to be really urgent.

II—On storage tanks for Irrigation in Narnaul District.

Rainfall.—As the greater portion of the water due to light fall of rain is absorbed into the ground, and is rapidly lost by evaporation, it is unnecessary to take into consideration for storage purposes any rainfall outside the monsoon months, July, August, and September. The averages for these months cannot be obtained for Narnaul itself, but for adjoining tracts the following have been taken from the Weather Reports of the Government of India:—

Sirsa . . .	12.01	averages 1st June to 30th Sept.
Bikaner . . .	9.26	ditto ditto.
Delhi . . .	24.75	ditto ditto.
Average . . .	15.34	

Assume that 12 inches is the average for Narnaul.

2. **Catchment.**—The catchment area will depend on the proportion of rainfall running off. In Mysore, where the monsoon rainfall is about 10 inches, the proportion of run off is assumed to be 0.25 (Molesworth). Mr. Binnie's observations for small rainfalls gave much smaller proportions for the Central Provinces. It is only possible to make a rough guess and to assume that for Narnaul the ratio of run off will be one-sixth. That is, two inches will be available out of the 12 inches of rainfall for storage purposes. One square mile of catchment then will yield $640 \times \frac{2}{3}$ equals 106.67 feet acres of water; or put in another way, six acres of catchment are required to give 1.0 depth of water per acre of the tank.

Assuming different depths of water in the storage tank, we have the following table:—

Depth of water in storage tank.	Catchment required per acre of tank.
10 Feet	60 Acres.
15 do.	90 do.
20 do.	120 do.
25 do.	150 do.
30 do.	180 do.
35 do.	210 do.

For a storage tank of one square mile (640 acres) and 20 feet deep, the catchment area required will be 640×120 acres, or 120 square miles. This question of catchment is will be seen imposes a limit on the size of the storage tank which must be adapted to the available area on which it is possible to collect the rainfall. In fact larger collecting areas will be necessary as the rainfall will be distributed over three months or so, and as there will be less by evaporation and absorption in the tank and consumption of the water for irrigation purposes it will readily be understood that smaller capacities in the reservoir will suffice.

3. **Evaporation and absorption.**—This brings us to the question of the loss by evaporation and absorption. In Molesworth the loss of water in tanks in Rajputana is given as 0.027 feet (average) per day all the year round. In April and May 0.0333 feet per day. These depths appear to be very small according to experience on the Punjab Canals. On the other hand it must be remembered that practically impervious soil is selected for building storage tanks on, and that to build one on more or less porous ground would be waste of money. Measurements in the hospital tank at Patiala gave the rate of sinkage at 0.1 feet per day, or from three to four times the above rates. In the escape channel at Patiala the rate was 0.2 to 0.3 feet per day. No one would think of constructing a storage tank on soil like this. In old established tanks the small rates of sink-

age are doubtless accurate; but for present purposes a rate of sinkage of 0.1 feet per day or 3.0 feet in the month should be allowed. Even this rate will probably be exceeded for some time in a new tank.

4. Now it is evident, the loss from evaporation and absorption being so heavy, that the stored water should be used as quickly as possible. But here the difficulty that presents itself is this. In a good year of average monsoon rainfall there will be a full tank but no demand for irrigation. The water will have to be kept till September or October for the *rabi* sowings and the loss will be very great. In a year of scanty rainfall the tank will not be full at any time perhaps, and certainly dry until good rain falls. If the rain is late no *kharif* could be sown, and the water would have to be stored for the *rabi* sowings. If the rains ceased early, on the other hand, the water stored could be used in maturing the *kharif* crops. In both these latter cases, however, the stored supply would be short. These three cases then will be considered:—

- (1) Rainfall normal in quantity and distribution.
- (2) Rainfall late.
- (3) Rainfall ceases early.

5. The next point to settle is the distribution of the 12 inches of rainfall. This may be assumed to be practically as follows:—

June . . .	10 days . . .	1.00 inches.
July . . .	31 do. . .	4.50 do.
August . . .	31 do. . .	4.50 do.
September . . .	20 do. . .	2.00 do.
92 days . . .		12.00 inches.

and further that in case (2) above the rainfall will be 5.5 inches in the first two months, and in case (3) above 6.50 inches in the last two months.

6. Now in the case of normal rainfall (1) where the water must be stored for use in *rabi* sowings as the loss will be 9.0 feet vertical before the water is brought into use, and another three feet at least while irrigation is going on, or 12 feet in all, it would not be much use in having a catchment that will give a less depth than 20.0 feet gross, or 11 feet net. In this case the ratio ^{water used in irrigation} _{water collected off catchment} equals $\frac{12}{11}$ equals $\frac{6}{5}$. A storage tank 11.0 feet deep would be required then with a ratio of 120 to 1. Catchment to tank as in paragraph 3.

The calculation being as follows:—

Month.	Days.	Reckoned from loss by		Balance in tank stored, feet depth.	Total depth in tank at end of month.
		Catchment, feet depth.	Evaporation, feet depth.		
June . . .	10	1.66	1.00	0.66	0.66
July . . .	31	7.50	3.00	4.50	5.16
August . . .	31	7.50	3.00	4.50	9.66
September . . .	20	3.33	2.00	1.33	11.00
TOTAL . . .	92	20.00	9.00	11.00	...

In the above calculation it should be remembered that a catchment of 120 acres has been allowed *per acre* of storage tank. Similarly if double this or 240 acres of catchment *per acre* of storage were allowed the gross depth collected would be 40.0 feet and the net depth $40 - 9$ equals 31 feet. That is to say with this ratio of catchment the storage tank would have to hold 31 feet of water. In the 11 feet tank above, with 80 feet used for *rabi* sowings, 8 feet acres of irrigation would be done, or 1 foot acre for every 15 acres of catchment. The deeper the tank the more the irrigation done, but on level country it would seldom be possible to get any great depth in a tank and still command the country. Another difficulty. In hilly country, on the other hand, the catchment area would probably be limited and a very costly dam would be necessary to store any large

quantity. In this case of normal rainfall water stored for rabi sowings (which is all that could be attempted) a tank one square mile in area to hold 11 feet water not would require a catchment area of 120 square miles, and the area sown, allowing 0.75 depth (for irrigation and waste), will be $610 \times 8 \times 7$ equals 6,800 acres roughly. This crop would still be liable to failure if the winter rains were unfavourable. The cost of the bund, etc., would be about Rs. 3,00,000 assuming 4 good years in 7, and a rate of Rs. 1 per acre the return would be $\frac{2,00,000}{7}$ equals Rs. 28,571 about, or say Rs. 2,800 at most after deducting maintenance charges, equivalent to 0.67 rupees per cent.

7. In the other two cases the quantity stored with the same ratio of catchment to tank, viz., 120 to 1, would be still less, viz.—

Rains late	5.83
Rains stop early	5.16

and the further losses before using the water being taken at 3 feet at least, the area irrigated would be 2.83 and 2.16 feet acres per acre of tank, or 1 foot acres for every 42 and 55 acres of catchment respectively. The returns will of course be proportionately less.

8. To sum up, the assumptions are that—

Rainfall	12 inches, distributed as stated.
Ratio of "run off"	One-sixth.

1. Q. (The President).—You are Resident Engineer in Patiala I understand?—Yes.

2. Q. How long have you been there?—I have just left, I was there for five years; I have been transferred to take over from Mr. Mullaly, Superintending Engineer.

3. Q. While at Patiala were the public works under you?—Irrigation works were under me and some of the buildings and roads.

4. Q. You had charge of the branches of the Sirhind Canal?—Yes, the Patiala branches.

5. Q. What was the arrangement between the British Government and Patiala State as regards water?—The Native States were entitled to 80 per cent. of the water entering the main line, there was a gauge at the head of the Native States branches, a discharge table was made out and that gauge determined the share entering the canal.

6. Q. We have heard some evidence about the reduction of water in the upper portions of the Sirhind Canal, to send more down, was that done in Patiala?—No.

7. Q. You know it was done in British Territory?—Yes.

8. Q. Was the Patiala State under any obligation to pass a certain amount of water to the tail where the canal re-entered British territory?—No.

9. Q. Supposing 50 per cent. were sent down could the three States appropriate the whole of it, or would they be obliged to pass on 20 per cent.?—They could appropriate the whole.

10. Q. For the sake of the districts to the south of Patiala which are suffering from want of water, do you suppose the Patiala State would come to any agreement to pass on the surplus water, keeping their 80 per cent.; for instance supposing the British Government is reducing irrigation in the upper part and can pass on 50 per cent., would Patiala be willing to keep 30 per cent. and pass on the rest?—I think they would under certain conditions.

11. Q. Was there any distress or famine in the Patiala State?—Yes, the times were rather tight.

12. Q. Were relief works going on?—Yes, one or two bunds and some of the rajbahs.

13. Q. You refer in your second note to storage tanks for irrigation in the Narnaul District, are there any depressions or basins existing?—I cannot say.

14. Q. Is there much well irrigation in Patiala?—Yes, in the Upper portions.

15. Q. Are the wells deep?—Fifteen to 20 feet deep.

16. Q. Does the area irrigated from wells receive canal irrigation as well?—A part of it does.

17. Q. Are they extending well irrigation?—I don't think so.

18. Q. (Mr. Hulton).—Is *takari* given by the Patiala State for wells?—I cannot say.

Loss by evaporation and absorption One-tenth foot depth per day. *Mr. Farrant.*
Ratio of catchment to tank area 120 to 1, i.e., 120 acres of catchment per acre of tank. *11 Nov. 01.*

Then the following depths may be stored:—

	Foot.	
(a) Normal year	11.0	} the conditions being favourable as regards command;
(b) Rains late	5.83	
(c) Rains cease early	5.16	

and the following areas may be sown, on an average of seven years:—

*Average for (b) and (c) 21 $4 \times 8 \times \frac{1}{2}$ equals 16 equals 16.67 acres, and 1 acre for every 42.67 $3 \times \frac{1}{2} \times \frac{1}{2}$ equals 10.00. 17 acres of catchment. Total for 7 years equals 62.67 acres per acre of tank, or average equals 7 acres, say, per acre of tank. In a tank of 1 square mile area (640 acres) the catchment will have to be 120 square miles, the cost of a bund will be about Rs. 3,00,000, the average area irrigated per year will be 4,480 acres, bringing in Rs. 4,480 gross revenue, or say Rs. 2,500 net, and a return of about 0.8 rupees per cent. In fact it is doubtful whether the working expenses would be met as it is doubtful whether any crop sown could be matured. If this were the case, taking a 4 per cent. interest rate, it would mean that Rs. 12,000 a year were being given to the tract sown to enable it to try and make a crop.

19. Q. (Mr. Higham).—You say that well irrigation is practised very largely in the Upper parts of the Patiala branches, how far down?—Twenty miles below the feeder line and right down the Choa Branch.

20. Q. In this tract what percentage of the cultivated area is allowed to be annually irrigated by the canal?—Nine to 14 per cent. and down in the lower portions up to 22 per cent.

21. Q. Do you know what was allowed in the Fazilka Tahsil?—Twenty-five per cent. I think.

22. Q. (Mr. Hulton).—Thirty-three per cent.

23. Q. (Mr. Higham).—Do you work to the allowance of 9 per cent.?—To give 9 to 10 per cent. involves making a long distributary and loss of water.

24. Q. Is the area in the upper zone greater than was estimated for?—I don't think so.

25. Q. You say this area is protected by wells and a smaller percentage is in consequence allowed; have these wells gone out of use as irrigation has been extended?—Wells have not been displaced by the canal.

26. Q. On the Choa Branch you have some areas that are in British territory?—A few villages.

27. Q. Mr. Dohin said he has always protested against canal irrigation being extended to these villages?—We have abandoned two rajbahs on this branch.

28. Q. Why was that?—Because the people would not take water and the soil was sandy in places; they work their wells for the good land.

29. Q. On the Kotla branch you have increased irrigation?—Yes.

30. Q. Above 25 per cent.?—Over 30 per cent. in places on the distributaries.

31. Q. You have got greatly increased supplies?—Yes, about 30 per cent. more.

32. Q. Is there any water available to pass on from the tails of the branches?—In 1899 when there was a great famine there was no spare water to pass on.

33. Q. What percentage were you working?—I cannot say; we did the maximum kharif area that year.

34. Q. That was a very dry year?—Yes.

35. Q. What has happened this year?—We have not taken anything like our fair share of water.

36. Q. You might have taken it and passed it on?—Yes.

37. Q. You have no inducement I suppose to take it?—No, you only damage the channels if you run more than is absolutely required.

38. Q. Do you consider you are debarred from asking for more water and passing it to the lower districts?—Not debarred but there is no object in doing so.

39. Q. There is no channel to put it into?—No.

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40. Q. Do you work up to your full share as a rule?—During the rabi season we always do, during the kharif as a rule we have not up to the present.

41. Q. Do you think it would be advisable to make any arrangement with the State by which kharif water would be passed somewhat freely into the Hissar District below all the branches?—I think it could be arranged, but the matter would have to be very carefully and fully considered first.

42. Q. The difficulty is chiefly one of treaty rights I suppose?—Yes.

43. Q. Have you water, that is the main point. Do you take all the supply you are entitled to?—We did in 1899, that is the only year in which we have taken it, in other years there has been water to spare.

44. Q. Do you fill village tanks beyond your own border?—Yes, in a few British villages adjoining the border.

45. Q. The State has no objection?—No.

46. Q. Do you make any charge?—No.

47. Q. Mr. King said just now that the State would not pass water without charge?—I have been there five years and have never asked for payment for water.

48. Q. You would only give it however if they take it at a convenient time?—Yes.

49. Q. What is the process, is there a Standing Order or what?—They send in special applications.

50. Q. I suppose the application may stick in the hands of certain people?—Not as a rule.

51. Q. There is a special application for each village?—Yes.

52. Q. There is no *sanad*?—No, but there are very few villages that can be supplied with water in that way.

53. Q. Because you have not got the channels made. I suppose if the channels were extended it could be done?—Except to the first village over the border you could not give it without great trouble and expense.

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Witness No. 35.—Mr. D. McGREGOR, District Engineer, Gurgaon District.

Note on Irrigation works in the Gurgaon District.

1. A number of bunds were made over to the District Board at last settlement by the Irrigation Department.

2. During the last 20 years a number of Irrigation Works have been constituted by the District Board which may be classed as follows:—

I. Bunds to intercept drainage of the hills and hold it up for inundation irrigation, and for giving water on the down-stream side for surface irrigation.

II. Protective bunds for keeping water out of Jhils and spreading it over lands where required.

III. Protective bunds for stopping the deposit of sand silt on village lands.

IV. Bunds put across streams for intercepting, diverting and spreading the water over village lands.

3. The construction of bunds may be briefly stated to have had the following effects:—Since the construction of the Ghata Bund the spring level of wells has been raised and wells which used to give very little water for irrigation in the villages of Jharsa, Gurgaon, Basai, etc., have all been benefited by precolation and during the last famine the wells in the villages kept up a good supply of water for irrigation purposes. It has been observed that along the banks of nullahs on which bunds have been constructed (such as the Bhadeshahpur nullah) the water level has risen for miles almost up to the surface. In the famine of 1899-1900 the villagers of Fazilpur, Tigra, Medawa, etc., dug *kachcha* wells along the banks of the nullah which gave them a good supply of water and some of the villagers had excellent crops. It is estimated that one pair of bullocks did more work on these wells than five or six pairs would do on wells in villages three or four miles from the nullah. Before the construction of the Ghata Bund the villages of Bairampur, Uharas, Tigra, Ghata, etc., could not raise crops as most of their wells were brackish. Now they have good sugarcane crops and their wells have become sweet. There are other similar lines of drainages on which bunds have been constructed and the results have been the same as those at Ghata.

4. A great deal more might be done to utilize the water in the nullah by construction of well- and either lifting the water by wind power or by water lifts worked by bullocks. The lift from the bed of the nullah to high ground level is not more than 12 to 15 feet and water might easily be lifted and channel made to lead it off from the well on to the different village lands where it is required. No expensive channels would be required as a simple water-way similar to those taken off from Rajbahas might be made by the villagers themselves. There is sufficient water in the sub-soil to irrigate the land of a number of villages if arrangements could be made for the construction of wells and lifting the water. The reason perhaps that this has not been tried before is that the District Board's funnees have been safely monopolised for the construction of bunds. Moreover the land in nullahs is either common village land or some of the villagers have sole proprietary rights in it and as a rule object to such works being constructed. But as it is very important—and especially in times of famine—that every means should be resorted to for the relief of villages where water is so deep for irrigation purposes such objections should not be allowed to stand in the way of utilizing water by the means above proposed.

5. There are several streams in the District to which the above remarks apply.

6. The water of wells in a great many parts of the District is brackish and it has been proved that by the construction of Bunds the wells have become sweet.

7. District Boards should be encouraged to undertake irrigation works if they have the funds. It would not be advisable to spend funds which would only benefit a few land owners. The construction and management of these Bunds can be more easily and profitably undertaken by the District Board than by the Public Works Department for the simple reason that the District Board employees are more in touch with the people.

8. The Board gets no credit for these works. They are empowered under Notifications Nos. 31 and 35 of 14th September 1899, to lay a water-rate. The question of the contribution to which they are entitled from Government in consideration of the increase of land revenue that may be due to the works, will most probably be raised at next settlement.

Financial Statement of Bunds.

Serial No.	Name of Bund.	Year.	Income.	Expenditure.	REMARKS.
			Rs.	Rs.	
1	Ghata	1879-80 to 1900-1901	3,096	21,749	Amount spent in famine not shown.
2	Gurgaon Training Works	1891-92 " Do.	15,325	54,517	Includes Bhadeshahpur, Fazilpur, Jbarsa and Channels.
3	Bargujar	1893-94 " Do.	344	1,355	
4	Shikohpur	1886-87 " Do.	61	746	

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Serial No.	Name of Bund.	Year.	Income.	Expenditure.	REMARKS.
			Rs.	Rs.	
5	Nannagpur	1886-87 to 1900-1901	160	1,314	
6	Manesar	1886-87 „ Do.	804	3,033	
7	Kasen	1883-84 „ Do.	60	3,052	
8	Raisina	1877-78 „ Do.	815	27,515	} Amount spent in famine not shown.
9	Mohammedpur	1879-80 „ Do.	478	90	
10	Sohna	1882-83 „ Do.	1,304	14,739	
11	Kasri	1886-87 „ Do.	12,000	22,080	
12	Chandani	1878-79 „ Do.	3,718	4,101	
13	Palla	1879-80 „ Do.	167	812	
14	Palli	1883-84 „ Do.	158	556	
15	Kotla	1878-79 „ Do.	49,281	19,606	19,606 spent on repairs only (original cost not known).
16	Akaira	1888-89 „ Do.	2,103	780	
17	Malai Water Conrao	1889-89 „ Do.	...	955	
18	Dhulawat	1884-85 „ Do.	1,116	7,961	
19	Thorn	1892-93 „ Do.	2,163	6,098	
20	Sakraia	1891-92 „ Do.	3,267	1,172	
21	Ghata Shamsabad	1884-89 „ Do.	...	1,979	
22	Man	1891-92 „ Do.	703	312	
23	Dangocha	1888-89 „ Do.	755	2,554	
24	Shahohokha	1888-89 „ Do.	10,628	1,541	
25	Chhaga	1890-91 „ Do.	...	2,046	
26	Dahina	1893-94 „ Do.	23	48	
27	Nand Rampur Pas	1893-94 „ Do.	25	9	
28	Khol	1885-86 „ Do.	...	4,030	
29	Taoru-Jatauli Road	1896-97 „ Do.	2,693	...	Charges met from roads.
30	Rakeri	1896-97 „ Do.	100	607	
31	Sabras	1896-97 „ Do.	137	1,164	

1. Q. (The President.)—You are in charge of the bunds in Gurgaon, I understand?—Yes.

2. Q. Do you belong to the Public Works Department?—Yes.

3. Q. How long have you been in Gurgaon?—Fourteen years.

4. Q. Were you there while the bunds were under the Public Works Department?—No, they had been taken over.

5. Q. You classify irrigation works, constructed by the District Board, under four heads; No. III is protective bunds for stopping the deposit of sand silt on village lands. Are there deposits a serious nuisance?—Yes, at the base of the hills there are large sand drifts.

6. Q. Regular drifts of sand?—They are regular sand hills.

7. Q. Do you find bunds successful in stopping them?—Yes.

8. Q. How high are these bunds?—One is 45 feet high and protects ten or eleven villages, there is a lot of sand between the hills which filled the borrow pits 30 to 40 feet deep, in one year.

9. Q. (Mr. Abbottson)—The sand is carried by water?—Yes.

10. Q. (The President.)—Is it ever carried by the air?—Yes.

11. Q. You say in your note “along the banks of the nullahs on which bunds have been constructed the water level has risen for miles almost up to the surface. In the famine of 1899-1900, the villagers of Fazlipur, Tigr, Mednans, etc., dug *kachcha* wells along the banks of the nullah which gave them a good supply of water and some of the villagers had excellent crops.” During that famine was there always water in these places?—Yes, in fact there was always a flow of water in the centre of the nullah.

12. Q. Where did the water come from?—It was percolation from the Ghata Bund.

13. Q. And the water was flowing on the surface?—Yes.

14. Q. How much irrigation was done there by these means?—About four to five square miles of cultivation was done by *kachcha* wells and leakage water.

15. Q. You had a good deal of distress in Gurgaon?—Yes.

16. Q. Had you extensive works?—These bunds were improved and others made, Mr. D. McGregor.

17. Q. The result was distinctly that they managed to keep irrigation going?—Yes, 11 Nov. 01.

18. Q. Is the Ghata Bund the only one in which there is this saturation of the soil?—No, there are similar cases, on five or six streams.

19. Q. In all of which, there is this percolation?—Yes, always where there is defined drainage and a bund between two hills.

20. Q. Do you think the same thing could be applied to streams like the Markanla?—Yes, my experience is that the first year percolation is very great; in a year or so it decreases and the water then percolates very slowly, but we always find water in the sub-soil near the surface.

21. Q. Where there is no bund the water is not near the surface?—No, the erection of these bunds keeps up a constant supply of sub-soil water.

22. Q. (Mr. Higham).—How far from the stream does the bund affect the wells?—Eight to ten miles right and left.

23. Q. What is the height of the bunds?—Some 40 feet, some 20 feet, it depends on where you have them.

24. Q. In an ordinary flood season are the tanks behind the bunds full of water?—Yes, up to the high flood level.

25. Q. You have got waste weirs?—Yes, and irrigation sluices.

26. Q. Had you water in them in the last year of famine?—Yes.

27. Q. You could not hold up the full supply?—No, we could only hold up half the full supply.

28. Q. In a year of extreme drought could you hold up half the full supply?—Yes.

29. Q. When does that disappear?—By the first of October for irrigation down stream; generally the inside of the basin is given up for cultivation.

30. Q. What do they grow in it?—Gram, wheat and barley, but mostly gram and wheat.

31. Q. How deep are these *kachcha* wells you speak of?—Nine to ten feet deep.

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32. Q. Do they last several years?—They lasted all through the famine; this year they will renew them I expect.
33. Q. You raise sugar-cane by means of these bunds?—Yes, that has been done since the construction of the bunds, not before.
34. Q. What proportion of the population was employed on famine labour in the District?—Three per cent., you cannot say the Gurgaon District was famine stricken, the Rewari Tahsil was famine stricken, four tahsils were not.
35. Q. Were you consulted about this famine programme?—Yes, as regards my district.
36. Q. Did you approve of the proposed works?—Yes, they were proposed by me in the first instance after which I was deputed to draw up the projects.
37. Q. A great number of the population of Gurgaon were enabled to go on with their agricultural works all the same during the famine?—Yes, but a lot left and went to the North-Western Provinces, because the wells are brackish.
38. Q. You say in your note "a great deal more might be done to utilize water in the Ghata nullah by the construction of wells and either lifting the water by wind power or by water lifts worked by bullocks, the lift from the head of the nullah to high ground level is not more than 12 to 15 feet." Have you ever seen wind power applied in this country?—No.
39. Q. You say again "there is sufficient water in the sub-soil to irrigate the land of a number of villages if arrangements could be made for the construction of wells and lifting the water." Why are more wells not constructed?—The nullah belongs to one village and they refuse to allow another village to enter on their lands.
40. Q. You could not construct wells without opposing some body?—No.
41. Q. Do you think Government should dig wells?—Yes.
42. Q. What would they cost?—Rs. 400 to Rs. 500 a well.
43. Q. Do you find that the District Boards interest themselves in the question or is it the Deputy Commissioner. Would the District Board take it up if the Deputy Commissioner was indifferent?—No.
44. Q. You say "the construction and management of bunds can be more easily and profitably undertaken by the District Board than by the Public Works Department for the simple reason that the District Board employees are more in touch with the people." Is it not the case that the Gurgaon bunds fell out of repair?—Yes.
45. Q. That was before the days of the District Boards?—Yes.
46. Q. Ordinarily would the District Board really interest itself in the matter?—Yes.
47. Q. Now as regards the wells, supposing it was arranged that they should be put in common ground, would the people take *takavi* advances for them?—No.
48. Q. Why?—The people of other villages would have no rights in them, only the people on whose lands the wells were to be constructed would have rights.
49. Q. Do you think for this kind of work the District Board is not a bad machine?—No.
50. Q. Can you propose many new bunds?—A number of new bunds have been proposed.
51. Q. Who initiates proposals for new works?—The Deputy Commissioner, I lay them before him.
52. Q. I suppose the land-owners who are interested come forward?—No; a report is drawn up showing who will benefit by the proposal.
53. Q. You work out the designs and estimates?—Yes.
54. Q. Is there any delay in getting sanction for as many works as are required?—They are generally sanctioned by the District Board and go to the Deputy Commissioner.
55. Q. Do they borrow any money?—No.
56. Q. Are the works you propose entered in the relief programme?—They have not been included.
57. Q. Do you think any of these works are sufficiently promising to be undertaken as soon as you get the money, or would it be better to keep them in reserve for employing famine labour?—They are not good enough to spend money on, except as famine labour.
58. Q. All your estimates are submitted to the Executive Engineer?—Yes.
59. Q. Who is he?—The Executive Engineer of the Delhi Division.
60. Q. Does he come round and inspect?—Yes.
61. Q. Have the items shown in your list been worked out?—Yes.
62. Q. (Mr. Wilson)—In making these bunds that you have made, were you supervised by the Public Works Department?—The Executive Engineer came round and inspected the work after it was finished, not during the construction.
63. Q. Did he inspect the site before the bund was constructed?—He came round and made an inspection to see if the project should be taken up.
64. Q. And as regards repairs of bunds?—That we carried out ourselves.
65. Q. Have you always got money to carry out the necessary repairs?—Yes.
66. Q. The Gurgaon funds are pretty well off?—Yes.
67. Q. Even in years of drought you have no difficulty in getting funds?—Are necessary repairs ever allowed to stand over?—We have not always found funds for the necessary repairs.
68. Q. Have you ever had to delay the construction of bunds?—No, but in the construction of channels there has been delay.
69. Q. Is there any difficulty about these bunds? The low ground behind the bund is likely to be silted up?—That happens in one or two places only. Silt is only brought down where there are sand drifts at the base of the hills.
70. Q. Where there is a great deposit of sand year after year, in process of time the whole of the low ground behind the bund will be silted up?—There is no difficulty about that, it will take a long time; the farmer is glad when the silt comes down as it benefits him.
71. Q. In the course of years the ground behind will get levelled up to the top of the bund, will it not?—No.
72. Q. Have the people been damming up the small ravines in the same way?—Yes.
73. Q. Individual cultivators dam up small ravines at the foot of the hills?—Yes.
74. Q. Making a sort of terrace cultivation?—Yes.
75. Q. Have you noticed any considerable amount of damming of this sort by individuals?—Very little, only one or two cases.
76. Q. On making new bunds have any objections been made by the people who thought that their lands had been damaged by them?—No objection was made.
77. Q. In a dry year would not the people in the low ground like all the water they could get?—The water does not spread out, it flows in a defined channel.
78. Q. With reference to what you say in paragraph 3, that would mean taking up land; would that not cost a lot of money?—Yes, if it had been done in the first instance it could have been done cheaply.
79. Q. Could the District Board buy up the land?—No; it would have to be done by Government.
80. Q. Would it pay?—Certainly.
81. Q. These works have brought the water-supply under control very much?—Yes.
82. Q. And added considerably to the produce of the District?—Yes.
83. Q. You say "a great deal more might be done to utilize the water in the nullah by construction of wells and either lifting the water by wind power or by water lifts worked by bullocks." How far will you send the water?—Four or five miles.
84. Q. Would not the percolation be such that no water would be left so far off?—No; I don't think so.

Supplementary Memoranda, etc.

(1) MR. P. J. FAGAN, Deputy Commissioner, Hoshiarpur District.

A.—General.

1. Montgomery District.

I carried out the settlement of tahsils Divalpur and Pakpattan from 1894 to 1899, and within certain circumstances laid down for me by Government and the Financial Commissioner in 1894-96 in a preliminary revision of the settlement of the 131 circles of tahsils Montgomery and Gugera which had been effected in 1892-94. For a period of about six months during the above years I was Deputy Commissioner in addition to being Settlement Officer.

2. I have no available monthly figures with me. The average annual rainfall for the twelve years 1886-87 to 1897-98 was approximately 10.5 inches. The bulk of this fell in the months June to September inclusive.

3 (1)—(4). I do not consider that any obstacle to extension of irrigation can be considered to originate in any of the matters referred. Population is sparse but would certainly increase rapidly with the extension of efficient canal irrigation.

3 (5). The supply in the existing inundation canals is undoubtedly uncertain, and, therefore, of course *pro tanto* prejudicial to successful agriculture; at the same time it is far better than no irrigation at all.

3 (6). The supply of capital to the Indian agriculturists is of course a universally pressing problem. I do not know that it is less acute in Montgomery than elsewhere. Recent legislation will accentuate the problem still further.

I would refer to paragraph 40 of my Settlement Report. I think that in the past capital expenditure on wells and canal watercourses has been a contributory cause of agricultural indebtedness.

3 (7)—(8). I do not attach much of any weight to these causes as obstacles of the kind indicated.

4. The system of protective well leases adopted for tahsils Divalpur and Pakpattan is fully described in paragraph 89 of the Settlement Report and I need add nothing here. The financial results can be seen in the table in paragraph 101.

The rules relating to fixed well assessments in the Ravi tahsils (Montgomery and Gugera) will be found in paragraph 59 of the above report.

The mass of the tenants in the district are more or less migratory tenants-at-will and it is extremely rare for them to effect any improvements either in the way of extending irrigation or otherwise.

5. So far as my experience goes, except in the case of the settlers in the Sahag Para Colony, loans are taken by land-owners to a very limited extent. The needful capital is mainly raised by loans from the money-lenders. The latter finance the zamindars in other matters and no doubt meets a pressure on him to prevent him from resorting to Government for capital to be spent on improvements.

The zamindar perhaps not unnaturally prefers to be financed from one source rather than from several.

Further, a loan from the Sirkar generally involves petty and annoying friction with the Sirkar's underlings.

The recent legislation in regard to land alienation will, I confidently anticipate, encourage more frequent resort to Government for financial assistance.

5 (1)—(6). It is difficult here to give answers apart from a consideration of the financial aspect of the questions involved. Any relaxation in the terms on which advances are made will of course tend *pro tanto* to popularize them more especially now that the zamindar's credit has been largely restricted. The latter fact seems to me to render some such relaxation highly advisable if not essential.

Turning to the six recommendations actually enumerated, I understand No. (6) to mean that the grants would be made gratis and of course free of interest. I do not consider that it would be advisable to adopt the grant-in-aid system generally, though power might usefully be taken to apply it to special cases where it might be shown to be needful or very advisable.

I am not in favour of No. (6).

Punjab.

No. (4) is provided for under Provincial rules and total remission under the circumstances indicated would no doubt be generally sanctioned by the Commissioner or Financial Commissioner as the case might be.

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No. (3) is similarly provided for by Provincial Rule 16.

There is, I think, much to be said for No. (2) if combined with a suitable shortening of the period of repayment or even, in view of the new conditions of agricultural credit, without it. Colonel Grey, Superintendent of the Bahawalpur State, has, I believe, shown arithmetically that advances free of interest can be made financially profitable to the State if enhanced assessment be taken into account. Remission of interest on agricultural loans would of course necessitate a reduction in the rate of interest charged by the Government of India in respect of the outstanding annual balance of the Provincial Loan Account (Civil Account Code, Article 123). No. (1) is in several respects cognate to No. (2).

The extent to which from a financial point of view interest can be reduced or altogether remitted depends, it seems to me, largely on—

(i) the extent to which Government of India will reduce interest on Provincial Loan Accounts;

(ii) the extent to which the period of repayment can be curtailed.

Provided that such curtailment is not too great, (2) would, I think, be far more effective than (1) in popularizing advances.

6. Yes, so far as my experience goes; it being understood that the "remaining cultivation" itself non-canal-irrigated and at a considerable distance from the canal-irrigated tracts; and that the irrigation referred to is canal-irrigation.

A notable instance is the effect of the Chonab Canal in drawing cultivators from the Ravi (Gugera and Montgomery tahsils) of the Montgomery district. This process combined with bad seasons has temporarily ruined the tract under reference.

As regards desire for extension of canal irrigation there now, I should think, few tracts of the South-Western Punjab, the people of which would not eagerly welcome such an extension.

B.—Canals of continuous flow.

7—11 and 13—22. There were no canals of continuous flow in Montgomery during my period of service there.

C.—Canals of intermittent flow.

12. So far as the Montgomery district is concerned I take the question to refer to the—

(1) Upper Sutlej Inundation Canals comprising the Katara, Khanwah and Upper Sahag; and

(2) the Lower Sahag and Para canals.

The information required will be found in considerable detail in (1) the last edition of the Montgomery Gazetteer at pages 11—15, 118, 122, 207 and 208; (2) the Final Report of the recent settlement, 1892-99, pages 3, 16—18.

D.—Tanks.

23—33. There are no irrigation tanks in the Montgomery district.

E.—Wells.

34 (1)—(7). Full information will be found at pages 118—121 of the last edition of the Montgomery Gazetteer.

The water-supply in wells at a distance from the canals may generally be obtained as procured. It is very liable to fail or diminish seriously in dry years. There are of course the usual variations in water-supply owing to differences in the water-bearing strata.

35 (1) and (2). See page 122 of Montgomery Gazetteer. Without (a) wells and (b) canals, barani cultivation is possible only in depressions so situated as to receive local drainage; it is by no means possible anywhere and everywhere even if soil is moderately good. Again (a) depends for efficiency on (b).

Unirrigated dafnli crops are rare if not unknown. A well, if suitably helped by a canal, enables a considerable area of dafnli crops to be grown in the vicinity of the well

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cylinder. Among industrious tribes, such as Wains and Kamtois, these dafali crops include vegetables and tobacco. Otherwise, I do not know that the presence of a well has a very marked influence on the quality of the crop as regards value.

35 (3). Effective well irrigation of course tends to increase the yield of crops both as regards gram and straw, chiefly in years of scanty rainfall or of drought.

In years of ample rainfall if there has also been a good supply in the canals the strain on the wells is much lightened and well irrigation contracts.

36 (1). The table at pages 151 and 152 of the Montgomery Gazetteer will supply the needful information.

Chahi indicates a crop receiving well irrigation alone.

Chahi-nahre indicates a crop receiving both canal and well irrigation.

Barani indicates a crop entirely dependent on rainfall.

The figures refer to a normal crop in a normal year.

36 (2). In a year of drought the average barani yield would be not more than a quarter of that shown, very probably less. It would be confined to depressions only.

37 (1). Cash rents are practically unknown in Montgomery. Details of the rates of produce rents in various tracts will be found at page 100 of the Gazetteer. It will be seen that the rate for well-irrigated crops is generally less than for barani crops. This is due to the greater labour and capital needed for well cultivation, and is of course counterbalanced by the more abundant yield.

The estimated average cash values of half the landlord's share of produce of different classes of cultivation are compared for the the Sollej tahsils in the table in paragraph 83 at page 68 of the final Settlement Report.

37 (2). These values constitute the theoretical standard for the revenue rates, which, however, in actual practice are pitched considerably below them.

38 (1). No.

(2). Difficulty is frequently experienced in reading a suitable substantive for the foundation of the well-cylinder. Owing to this and in order to avoid the cost of a deep shaft the cylinder is often allowed to rest in all unsuitable stratum with the result that the well more or less quickly falls out of repair.

No assistance, so far as I am aware, has been given by Government or by Local Bodies on the lines indicated.

I am inclined to think that the Irrigation Report might be able to give useful advice and assistance.

39. I have dealt with this matter in my oral evidence.

40. Temporary wells are not common in Montgomery. The depth to water is, I think, generally too great. There are a considerable number of unlined or partially lined *kachcha* wells, but these are intended for more or less permanent irrigation.

I do not consider that much of anything is possible, or perhaps advisable, so far as Montgomery is concerned in the direction of encouraging the excavation of temporary *kachcha* wells in years of drought in tracts not served by canals.

(2) PANDIT HARI KISHAN KAUL, Settlement Officer, Muzaffargarh.

A.—General.

1. Q. Muzaffargarh. I have been Settlement Officer of this district since 7th August 1898.

2.

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Tahsil.	AVERAGE RAINFALL OF TEN YEARS.												
	April.	May.	June.	July.	August.	September.	October.	November.	December.	January.	February.	March.	Total.
Muzaffargarh .	19	23	35	18	135	27	07	08	33	42	53	25	592
Sioanwan .	21	22	55	155	181	4	...	15	23	42	49	42	641
Alipur .	14	14	54	118	147	183	...	05	15	35	36	12	503
District .	18	2	43	143	154	4	02	09	24	4	43	26	578

3. *Sparsity of population.*—The population is dense enough for extension of cultivation to a considerable extent if sufficient water is available. There is, however, a limit. For example, the whole of the Thal could not be brought under the plough by the inhabitants of this district and cultivators would have to be imported.

No. For plough cattle, the people of this district draw mostly upon the Province of Sindh and there seems no likelihood of the supply remaining short of the demand.

No. Manure is not needed for kharif grown on canal water and the cattle that would have to be kept in a canal-irrigated tract would produce sufficient manure for the rain crops that have to be manured.

No. The soil in the parts where canal extensions can be made (in fact throughout the whole district) is particularly suited to canal irrigation.

No. The supply of the inundation canals is not very uncertain in this district, and even if they run for four months in summer, the supply is sufficient for the existing conditions of agriculture.

Much capital is not required for extension of cultivation on the canals. A man begins by sowing kharif crops on canal water alone. Having made a little money he sows a well. The most important expenditure is that on sinking a well in order to assist canal irrigation, and for this a more liberal provision of funds for takavi would be

a great advantage. The other crops generally sown on canals are not so expensive excepting sugarcane which the richer landowners alone attempt to grow.

No. As cultivation in the secured tracts of this district depends mostly on canals, the rent rate for extended canal irrigation is not higher than that charged on similar lands in the neighbourhood. The proposals that I have made for assessing extended canal irrigation are very moderate, and I do not think any one will hesitate to extend cultivation with canal water merely for fear of the assessment which he will have to pay. Extension of cultivation on holdings that have been assessed as canal irrigated will pay no enhanced assessment.

I apprehend no other difficulties. If there is anything which the people dread, it is the last occupier's rate proposed to be substituted for *chhar* (statute labour for clearance of canals). But if the rates proposed by me are sanctioned I believe people will not feel them heavy.

No. irrigation works of any magnitude are now constructed in this district with private capital. No remissions are granted on that account and none seem to be needed.

Loans under the Land Improvement Loans Act are taken for sinking wells, but the money allotted to the district under this head is very small. If a larger provision was made, loans would be taken more freely. I would

recommend the following measures for encouraging loans:—

- (a) Reduce the interest to one-half.
- (b) Partial remission of the advances if the sub-soil under the well has turned out to be bad and if it has not been possible to fix the well on satisfactory ground even after incurring additional expenses on sinking it unusually low.
- (c) Extension of the period of repayment if necessary. Total remission of the interest or capital is not needed in this district.

6. Not much. I have not come across any marked instance. The people are very keen on having canal extension all over. The people of the Thal are simply dying for canal water, and the Zemindars of other inland tracts also try their best to have canals extended.

B.—Canals of continuous flow.

7 and 8. With the exception of the riverain tracts where the lands are flooded by the rivers, and the Thal which is beyond the reach of the existing canals and where crops are raised on wells alone, the cultivation in this district depends mainly on canal water. It is, therefore, difficult to make any comparison. The chahi irrigation in the Thal is extremely small and may in the event of the construction of a large canal be neglected altogether.

9. Almost all the canals in this district though built originally by the people themselves now belong to Government. There is only one private canal, and on that the owner of the canal does not charge the irrigators anything for the price of water. The clearance of canals has hitherto been effected by statute labour; but the question of substituting a cash occupier's rate in lieu of this labour is under consideration. As I have said before, there is little cultivation in this district without the help of canal water. In holdings which have the advantage both of a well and of canal water, the rent paid on chahi cultivation is usually the same as that paid on chahi or chahi nahri. In tracts which are beyond the reach of canal irrigation the rent paid on chahi cultivation is usually $\frac{1}{2}$ of the divisible produce, while on the canal irrigated lands it is generally $\frac{1}{3}$ rd. No separate water advantage revenue is charged in this district, the whole of the revenue on nahri lands and $\frac{1}{3}$ rd of that on chahi nahri lands being credited to the Canal Department. All unassessed land which is broken up hereafter with the aid of canal water will pay a water advantage rate of 10 annas per acre. (This has been sanctioned for one tahsil and will probably be sanctioned for the other tahsils as well.) This water advantage rate will be charged on the area of matured crops every year.

10. The tenant generally incurs the initial expenditure in the way of clearing the land constructing the water-courses and sinking a well. If he does so he usually gets the proprietary rights of half the land so cleared (ndhlapi). If the owner incurs the expenses no concession is made to the tenant.

11. No deterioration has apparently resulted from irrigation of the soil without manure, apparently because the lands sown with kharif crops with manure are allowed to remain fallow during the rabi and grow strong enough for a crop in the succeeding kharif. In certain low-lying tracts, excessive irrigation has resulted in water logging, but this is one of the causes which have brought about the water logging. These causes were explained for one tract in paragraph 12 of my Assessment Report of the Sinanwan Tahsil. Briefly the set of the river, the low level of the lands, the flowing of water in canals higher than the ground level excessive irrigation of rice fields all combine to cause water logging which is largely augmented if there is a heavy fall of rain. During the past two years the rainfall has been small and a very successful attempt has been made to economize the supply of water in these tracts with the result that water logging has diminished to a very considerable extent. I have had no experience of draining irrigated lands. A scheme for draining one of the water-logged tracts in this district was contemplated, but was given up as it was found impracticable.

12. This question is identical with question 7.

14. If the supply of water in inundation canals commences late, it becomes impossible to sow Indigo and cotton, and if it ceases too early the rice crops dry up. And these are the three most important of the nahri kharif crops of this district.

15. So far as the kharif is concerned the canal supply is supplemented by irrigation from wells in respect Punjab.

of cotton and sugarcane, i.e., the land is watered from wells before the canals begin to flow and after they stop. For the rabi, the canals supply enough water for ploughings or sometimes for sowings. After that wheat, barley and other rabi crops have to be watered from wells. Gram, peas and musur, which are usually sown as double crops on rice fields, require no well irrigation.

16—18. These are identical with questions 8—11.

20. Silt clearances; etc., are effected by statute labour at an average rate of slightly over two labourers per acre per annum, the nominal value of which is rather more than 8 annas per acre. The absentees pay a fine of 8 annas per labourer. These fines are constituted into a fund called Zar-i-Nagha, which is utilized for works connected with the maintenance of the canals. The system does not work well, and it is contemplated to substitute a cash occupiers' rate for it.

21. Almost all the canals of this district were constructed by irrigators under the guidance of rulers for the time being. Ever since annexation, however, the canals have been under the management of Government and since 1879 they have been under the charge of an Executive Engineer of the Irrigation Department.

22. No. This leads to complications and mismanagement.

E.—Wells.

34. The district is divided into three tahsils and each tahsil is sub-divided into assessment circles. Taking all the three tahsils together there are the following assessment circles:—

- The Thal circle;
- The Thal-Nahri circle;
- The Pakka circle;
- The Sindh circle;
- The Chenab circle;

and the Chahi Sailab circle.

(1) The average depth of wells varies from circle to circle and from season to season. In winter the level of sub-soil water sinks, while in summer when the rivers are in flood and the canals are running the water level rises in some places right up to the surface. Leaving exceptional circumstances out of account the average depth of permanent wells may be taken as varying from 5 to 15 feet in the Sindh and Chenab circles, 10 to 20 feet in the Pakka, 8 to 16 feet in the Chahi Sailab and 20 to 30 feet in the Thal and Thal Nahri circles.

(2) Well water in the Thal and some parts of the Pakka circle is more or less brackish, but after the well has worked continuously for some time the saline taste grows less and less acute. The water-supply is limited and if a well is worked beyond a certain limit the water fails. Years of drought are more common in this district than years of good rainfall and what has been stated above refers to ordinary years. In years of good rainfall the water supply increases temporarily and at the same time there is less demand for irrigation.

(3) The average cost of constructing a well is from Rs. 200 to Rs. 300.

(4) A pakka (masonry) wall is supposed to last a hundred years, but while there are old wells which have lasted for over a hundred years, the new ones are known to collapse much sooner. This is probably due to a false economy in making the wall of the well thinner and taking less trouble on fixing the bricks.

(5) Water is lifted everywhere by means of the Persian wheel.

(6) The average area attached to and commanded by a well is:—

- 11 acres in the Thal;
- 20 or 21 in the Thal Nahri;
- from 16 to 22 in the Pakka;
- „ 13 to 22 „ Sindh;
- „ 17 to 21 „ Chenab;
- and 11 acres „ Chahi Sailab.

(7) The average area irrigated annually is:—

- 13 acres in the Thal;
- 13 or 14 acres in the Thal Nahri;
- 10 to 14 „ „ Pakka;
- 10 to 16 „ „ Sindh;
- 13 to 18 „ „ Chenab;
- and 8 „ „ Chahi Sailab.

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35. As I have stated before most of the rabi crops depend in this district on well irrigation. A cultivator can never be sure of growing wheat which is the most important crop in the district until he has a well to depend upon. Without well water it is only possible to grow cheap rabi crops like gram, peas, etc.

36. The yield of purely nahri rabi crops is usually much less than that of chahi nahri crops and this difference is more apparent in a year of drought. In years of good and timely rainfall crops unassisted by wells flourish just as well as those irrigated from wells. In the Pukka circles I have estimated the annual value of the average outturn of chahi nahri and nahri lands as below:—

	Chahi Nahri.	Nahri.	Difference.
Sinanwau . . .	Rs. 12	Rs. 9	Rs. 3
Muzaffargarh . . .	" 14	" 10	" 4
Alipur . . .	" 13	" 11	" 2

I have noted the difference above. These figures relate to an average of normal years. In a year of drought the difference would be still greater.

37. The cultivator does not pay the owner any additional rent on account of well irrigation. Indeed the rent of entirely well irrigated lands is usually much less than that for Nahri or Sahib lands. Nor does Government charge anything extra for 20 years after the construction of the wells. After the expiry of this term the abiana (lump assessment for each well) is charged in the circles under fluctuating assessment, which, according to my proposals, will never exceed 8 annas an acre of irrigation. In the circles under fixed assessment no new assessment is imposed during the term of settlement. The lump assessment in the circles under fluctuating assessment is paid irrespective of

the area irrigated as long as the well is in working order. When it falls out of use no abiana is charged.

38. No difficulty at all is encountered in the matter of finding water. But difficulty is sometimes met with in finding a sufficiently hard stratum to rest the foundation of the well on. A well resting on soft sand sinks from year to year and gets damaged, while one resting on a very hard stratum of some sort of clay fails to supply sufficient water.

No assistance has ever been offered here by Government or by local bodies in the shape of expert advice. I think it is worth trying. The best plan would be for the District Board to employ an expert with boring tools, etc., who should go round the district and tell people intending to sink new wells how deep the water level was and how deep they should sink the well to find a suitable stratum to rest the foundation on. Perhaps it would be best for the Director of Land Records and Agriculture to employ a few such men and send them from district to district, the District Boards paying the expenses. In a year's time it would be possible to see whether the measure is or is not a success.

39. No. People would not like it and would strongly object to such philanthropy.

40. Temporary wells are constructed only in the riverain circles where they help in years of drought or poor floods. They do not last long. They can be encouraged by granting protective leases for them; and I am going to propose that temporary wells of a somewhat improved form should be granted, protected leases for terms not exceeding ten years. The encouragement offered for purely temporary *kachcha* well is that they are charged half the abiana (lump assessment) for the first year which I think quite sufficient.

(3). Mr. W. P. BRODIE, A.M.I.C.E., Superintending Engineer, Derajat Circle.

A.—General.

*Mr. W. P.
Brodie.*

1. The answers refer to the Derajat Circle, which comprises the canals of intermittent flow in the Multan, Muzaffargarh and Dera Gazi Khan Districts of the Punjab, of which I have been in charge for 2½ years.

2. The average rainfall is—

January . . .	0.37 inches.
February . . .	0.42 "
March . . .	0.27 "
April . . .	0.25 "
May . . .	0.32 "
June . . .	0.33 "
July . . .	1.67 "
August . . .	1.27 "
September . . .	0.34 "
October . . .	0.04 "
November . . .	0.07 "
December . . .	0.19 "

TOTAL . . . 5.54

Hot weather, April to September . . . 4.18 "

Cold weather, October to March . . . 1.36 "

TOTAL . . . 5.54 "

The rainfall is too scanty and too uncertain to permit of crops being grown on rain cultivation only.

3. There is no obstacle to the extension of irrigation under the sub-heads noted. There would, however, be an extension of irrigation, and existing irrigation would be extended if all the canals were provided with a proper system of distributaries by which the waste of water would be reduced, and the supply more efficiently and economically distributed (see also reply to question 12).

6. Cultivators will always go where cultivation is easiest and best secured, and extensions of canal irrigation consequently injuriously affect other cultivation in their neighbourhood. The desertion of tenants to the Chenab land when the Chenab canal was opened is notorious, and there was a similar experience, on a much smaller scale, in the Multan district, when the Sidhnai canal was opened. People whose lands are outside the canal irrigated area are always desirous of having canal irrigation extended to them.

C.—Canals of intermittent flow.

12 (1). The canal is fed from a head on the river. The head is dug and cleared in the cold weather to a depth such that in ordinary course it will have a sufficient supply for opening about the 26th of April. A great object is to place the head so as to draw the supply from a perennial creek or side channel in which there is less silt than in the main stream. River action and river changes may, however, injuriously affect the head; for instance, the river may desert the channel or the main stream may come into it, and set up erosion at the canal head, in which case the head must be abandoned and a new one dug.

12 (2). Distribution of supply is not present, made through watercourses taking out of the canal, many of them being of an excessive length in order to irrigate villages lying at a distance from the canal channel. In high supplies the whole or nearly the whole irrigation is by flow, but in low supplies much has to be done by lift. This is effected by means of Jhollars or Persian wheels erected on the canal bank and in the watercourses. The whole system is inefficient, the long watercourses waste a large amount of water, the command is defective, while a fair distribution of supply is excessively difficult and troublesome and is practically never attained. What is required is a system of properly aligned distributaries that would carry the supply in bulk along the high ground to the various villages where watercourses of moderate length would serve to distribute the water to the fields. By means of stop dams in the main channel these distributaries could be run full in rotation even in low supplies, and in this way the water would be distributed over the canal area far more fairly and efficiently than is possible at present. The advantage to Government would be the saving of water at present wasted (allowing of much needed extensions being made), while the cultivators would have a fairer and more reliable water supply, most of their present lift irrigation would be replaced by flow, and they would be saved the cost of clearing the excessively long watercourses. Moreover, with a proper system of distributaries an extension of canal irrigation could be made far more easily and efficiently than is possible at present. Something has been done to introduce distributaries, but the work is hampered by want of funds.

12 (3). The duration of supply is dependent as follows:—

If there has been a heavy winter snow fall in the hills (which generally happens with good cold weather rains) so that the snow line is low and the snow area very large

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then the rivers rise early, and the canals begin to flow early (say 15th April). In such a case the rivers will keep high all through the hot weather, and the canals will have an ample supply. If, however, the snowfall is scanty or if there is little or no fresh snowfall (corresponding with a dry cold weather), then the rivers will be slow in rising and will not rise high till the rains set in. In such a case the canals will be late in opening (15th May or later) and will have an insufficient supply till July.

Again if the hot weather rains are ample and do not cease untimely, then the rivers continue high, and the canals continue in flow till late (say 15th October). If on the other hand, the rains fall early the rivers fall early, and the canals are dry by the middle of September or even earlier.

The duration of supply is also affected to a considerable extent by the condition of the canal head. If the condition is favourable so that little or no silt is deposited, the canal will continue in flow much longer than when the condition is unfavourable, and the canal head is more or less heavily silted. Under very favourable conditions the canal may continue in flow throughout the year.

With these explanations the following answers may be given:—

12 (3) (a) 180 days.

(b) 150 "

(c) 120 "

Local rain is of benefit, especially in the cold weather when it helps to mature the crops and to materially improve the outturn.

13. It is undoubted that irrigation increases the value of the produce of land under (1), (2), (3), but I am not able to say by how much.

14 (1) By a too late commencement, the more valuable crops, sugarcane, indigo and cotton, either cannot be grown or only very imperfectly grown, and the value of irrigation is diminished by about 20 per cent.

(2) Whilst by a too early cessation, the kharif crops are imperfectly matured, and the area of rabi waterings is much curtailed, and the value of irrigation is diminished by about 35 per cent.

15. As was stated under question 2, the local rainfall is too scanty and uncertain to admit of rain cultivation, and the value of the produce may be said to vary according to the working of the canals, and this has been explained under question 12 (3).

17. The canals with two exceptions (noted under question 21), belong to Government. On some canals the other system is in force where the cultivators are assessed to ehher labour, but as this system is being abolished, and replaced by occupiers' rates, it need not be further noticed. Taking the Multan District as an illustration, the Government canals are assessed with a water advantage rate, which varies in different Tehsils from Rs. 0.14 to Rs. 1.4 per acre, and an occupiers' rate which varies

Assumed to be paid by owner.

Paid by occupier.

an occupiers' rate which varies

from Rs. 0.10.6 to Rs. 2.4 per acre according to the crop and whether the irrigation is by lift or flow. These rates are levied on areas actually matured in each year. For private canals see question 21.

18. The private expenditure necessary to bring the water to the field consists of clearing and maintaining the water courses and depends on the length of the watercourse. On an average of long watercourses it would be Rs. 1.8 an acre; it would be more on the longest watercourses and less on the shorter. It is generally incurred by the landlord.

19. Temporary local damage has at times been done by waterlogging due to excessive supplies being run on the fields for rice cultivation and to water wasted. The evil is remedied by reducing supplies, but until distributaries and proper watercourses heads are constructed, it will not be possible to bring the distribution of supply under such control as will altogether avoid local and temporary waterlogging in certain tracts. As the tracts subject to waterlogging are below river flood level and have to be protected against the river by flood embankments, and no waterlogging takes place in the flood season no attempt at drainage has been made.

20. On canals where the ehher system is in force the maintenance is done by ehher labour. Elsewhere it is done from Imperial funds. The cost varies, but the average may be taken at Rs. 1 per acre.

21. There are two canals in the Multan district that were constructed by private persons—

(a) Ghulamwah owned by Ghulam Muhammed. The maintenance or canal clearance is done by the cultivators, and outside landowners pay to the owner a cash rate which is usually Rs. 0.10.0 an acre for flow and Rs. 0.8.0 for lift. The Ghulamwah irrigation is assessed to canal advantage rate of Rs. 0.8.0 per matured acre for flow and Rs. 0.6.0 for lift. In addition the owner pays to Government a royalty in a sum of Rs. 500 a year which falls at the rate of one anna per acre irrigated. There has been no trouble in the working of this canal.

(b) The other canal called the Hajiwah has not done so well, and it was found necessary for Government to take over the management owing to family dissensions amongst the sons of Ghulam Kadir Khan who excavated and owned the canal. The canal has been under Government management since 1889. The assessments are similar to those on the other canals with this modification that on irrigation on lands originally granted to Ghulam Kadir Khan and now owned by his descendants the charge per acre matured is much lighter than on other irrigation.

22. I do not consider that it is now desirable to encourage the construction of private canals. Such works are better done by Government.

(4) MAJOR MORTON, R.E., Executive Engineer, Multan Canals Division.

A.—General.

1. Q. The replies below refer to that portion of the Multan district watered by, or adjacent to, the Multan Canals (for detail of these canals see replies to Head C Canals of intermittent flow below).

I have been in charge of the Multan Canals as Executive Engineer since April 1898.

2. Q. There is no obstacle to such extension of irrigation as is ever likely to be proposed either of the Sidhnai system (see reply to question Head C) or the Multan Canals owing either to:—

- (1) scarcity of population,
- (2) insufficient supply of cattle,
- (3) insufficient supply of manure,
- (4) unsuitability of soil,
- (5) lack of capital,
- (6) fear of enhanced rent or revenue,
- (7) uncertainty of tenure or defects of the Tenancy Laws or for any other reasons than those stated below:—

To a certain extent the uncertainty of the supply in the Ravi at Sidhnai head of the Sidhnai system, will prevent much further extension should it be advisable to irrigate

lands not at present reached by that system. Within the last three years the Sidhnai Canal itself has been extended to take up land near Multan not previously irrigated at all, amounting to about 50 square miles in extent, and an extension is now being carried out in order to irrigate land poorly irrigated by one of the Inundation Canals amounting to about 20 square miles of area, and it is probable that within the next three or four years a further extension to take up another 20 or 30 square miles will be proposed in order to further irrigate land at present not fully reached by existing Inundation Canals.

These extensions have been or will be carried out without any material alteration in the supply in the canal. A portion of the land on the Sidhnai is undoubtedly over irrigated, i.e., the area irrigated bears a far higher percentage to the total area than the like area in other parts of the canal and by somewhat reducing the larger area irrigated, in some places water is available for extension. In some years the supply in the Ravi is abundant, and it would seem that there will be a return shortly to a period of abundant supply. The two years of failure which have occurred within the past four years of this canal's working are probably quite exceptional. It would not be safe to say at

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present whether any extension could or could not be made beyond those referred to above.

There appears also to be considerable probability of other canals being brought in to take up such portions of the Multan district to which the Sidhni Canal might perhaps be extended.

In regard to the Inundation Canals there is no obstacle to extension southward. The irrigation limit has been reached east-ward as the ground slopes up rapidly. Southward an extension is now being surveyed which will take up most of the land not irrigated (see plan* attached No. 2).

4. Q. The only exception that I know of is a partial exemption of the water rate on the Sidhni Canal for new wells sunk. This exemption is for a term of 20 years and is secured by assessing the area irrigated by such new wells at the lower rates. The concession is liberal enough (same further remarks made on the subject in reply to question 39 below).

5. Q. I can give no reply to this.

6. Q. I have never heard of any tendency except a purely temporary one, on the part of cultivators to leave unirrigated parts for tracts under canal irrigation, but it is an undoubted fact that in cases of bad years well cultivation in certain parts of the district, notably the Ravi Hitta (see plan* attached No. 1) are deserted for the time being at any rate and the cultivators go to the Sidhni or perhaps across the Ravi to the new Colonies on the Chenab. In the same way there was a certain amount of emigration from the Sidhni in 1898-99 to the Chenab Colony, but a good many of these men came back in the following year. The Ravi water is more fertilising than the Chenab water and the Zemindars far prefer the land on the Sidhni to what on the Chenab Canal in consequence. The development of the Jhelum Canal will most probably have no effect on the Sidhni irrigation if a succession of bad years occur again, as the Jhelum water possesses the same, or nearly the same fertilising properties as does the Ravi.

I have never heard of any great demand for an extension of irrigation. As far as I recollect the only application for an extension was in the case of the Sidhni to the area on one of the Inundation Canals already alluded to, and now in progress.

C.—Canals of intermittent flow.

I class all the canals in the Multan district under the above head.

The canals forming the Sidhni system are intended to be perennial canals, but owing to the periodical failure of the supply in the Ravi, at Sidhni, these canals are intermittent.

12. Q. (1) (a). There are two groups of canals forming the Multan canals—

(a) The Sidhni system consisting of—

- (1) the Sidhni canal,
- (2) the subsidiary canals—
Fazilshah,
Koranga,
Ahdul Hakim.

The Sidhni, Fazilshah and Ahdul Hakim take off from the left bank of the Ravi, either at, or close to Sidhni and the Koranga from the right bank. Below the heads of all these canals is a needle-dam, by means of which the lowest supplies in the river can be forced into one or more of the canals.

The Sidhni gets the first share.

The balance of water goes first to Fazilshah and Koranga equally and lastly to Ahdul Hakim when there is not enough for all.

(2) (a). The water is distributed to the land by means of Rajbahs or Major distributaries and minors on the Sidhni and by means of minors on the other three canals which latter are merely Rajbahs.

From the Minars in all cases short water-courses carry the water on to the fields. The land is divided out into "chaks" or areas comprising several holdings and generally about 200-400 acres in extent, each "chak" has a water-course taking off from the minor, and in rare cases, if the ground necessitates it from the Rajbaha direct. At the head of each watercourse in the distributary bank is a pipe at first laid in the bank and afterwards built into a masonry outlet. The size of the pipe in the minor or

Rajbaha for the "chak" is regulated by the size of the "chak" and the head available to give the required discharge. Distribution of water from the water-course to the various holdings in the "chak" is made according to a regular table drawn up allotting so many hours supply to each holding according to its area.

3 (a). The period for which the Sidhni and the three subsidiary canals were in flow in 1898-99 a year of ample rain-fall; in 1898-99 a year of scanty rain-fall; in 1899-1900 a year of draught is shown in the accompanying statement.

1 (b). The second group of canals in the Multan District is formed by the Inundation Canals. As far as these replies are concerned the Inundation Canals take off from the River Channab east or left bank, mainly above Multan. There are now four heads:—

1. Mattithal;
2. Wali Muhammad and Daurana Langana;
3. Sikandarabad and Gajjuhatta; and
4. Sikandarwah and Belochanwah.

The first three of these take up from the main stream of the river and the fourth from a side creek. The latter is preferable, but the river does not admit of the heads of the three first named being taken from a creek. The heads of 2 and 3 are old creeks utilised for the purpose. The head of Mattithal and of Sikandarwah-Belochanwah are channels dug for the purpose.

The heads are thus open to the river. Further down, at a considerable distance, and away from any possibility of erosion is the head regulator which controls the supply and prevents the flood passing down and doing damage.

Sikandarwah-Belochanwah has no regulator at present, but one will be built this year.

The surplus water at the regulator escapes either, as in the case of the Sikandarwah canal, by a specially dug escape channel controlled by a regulator or over the banks and adjacent land back to the river. In July and August there are often periods of considerable anxiety when the floods are high as to whether this excess supply will be passed off safely or not. So far no damage has ever occurred, but it is conceivable that a high flood accompanied by local rainfall, the latter necessitating the closure of or reduction of the supply in the canal, might test the head regulator pretty severely. There being nothing to prevent the supply in these canals fluctuates enormously, even day by day, according as the supply in the river fluctuates, rising with rain-fall on the catchment area and falling with the subsidence of the flood.

2 (b). There are practically speaking no distributaries on these canals. The Gajjuhatta (a branch now of the Sikandarwah) has branches but these were in former days separate canals which have now become part of the Gajjuhatta system. This canal and its branches have several minor channels locally known as "Larhs". These Larhs are really large water-courses and have never been properly aligned. The only difference between a Larh and the other water-courses on these canals is that the Larh is a canal as defined by the Canal Act, is controlled and maintained by Government and consequently it is possible, to a very limited extent, to supply water to cultivators equally. Over the water-courses Government has practically no control and can only interfere on the application of one or more of the owners, and then only to a limited extent. There are in all eight such Larhs on the Gajjuhatta, and none on any of the other canals.

So far these Larhs and the main canals have for the most part opened up in a few cases protected by large masonry openings from which the water is taken. Pipes are being put in now over most of the system and the large openings reduced in size. Many, if not most, of the water-courses are long and tortuous with high banks the accumulated deposit from many years of silt obstructions. The waste of water is enormous.

13. (1) (a) The Sidhni Canal, as it does not flow in many years beyond the middle or end of October till the end of the rabi, has, in such years, only a limited effect on the rabi area. For early rabi crops, which require but little water, such as gram, the Sidhni Canal will generally prove sufficient, but the maturing of the principal rabi crop, wheat, must be left to wells helped in rare cases by rain. The area of rabi under pure Chhni and that raised on Barani, Ahi, and Sailah lands together is not inconsiderable.

fit for anything but rice growing, the soil is much improved especially on the Kavi canals, by a succession of rice crops and consequent copious irrigation from canal water which fertilises the land and makes it possible to produce wheat.

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It need hardly be mentioned that in a country of so small a rainfall, canal irrigation is the only one which will produce two crops with certainty and facility. With its strong tendency to fail at the end of the kharif or beginning of the rabi season, the Sidhna is somewhat of a failure as a complete two-crops producing canal, and, owing to the supply being to a certain extent limited (i.e., by the capacity of the canal), it is not, as on the Inundation Canals, possible to give a supply at the end of the kharif season for the first waterings of rabi crops.

(2) (b). There is no doubt that on the Sidhni, as doubtless in all cases of canal irrigation, the better classes, i.e., the more valuable classes of crops are possible.

*Statements attached show this clearly. It may be mentioned that in the Kharif it is difficult to differentiate between Chahi-Nahri and Nahri, and really the two classes should be grouped together as the joint produce of the canals.

In the statement of amount and value of principal crops it is shown that the total amount and value of such crops as cotton, rice, sugarcane (not largely grown here) indigo is—

So that the total area and value of these crops on Ohali-Nahri and Nahri together in the three Tehsils is, in round numbers :—

(3) (a). I have no details of yield by years, so cannot say to what extent the Sidhmal canal increases the yield in various years. Locally there is little difference between the rainfall in years of drought and ample rainfall, but small rainfall in the Ravi catchment area causes a failure of the supply in that river, and early cessation of the supply in the canal.

Early closing of the canals will affect the area under cotton which requires water to the end of September, or, if planted late, until the middle of October.

If supplies cease before the middle of October, the area under rabi will be small and the crops which are sown will have to depend on well water or trust to rainfall in the winter.

The Inundation Canals are more regular in their flow. There is every probability of these all being open before the end of April, and they rarely flow beyond the end of September. The cultivators therefore know fairly accurately what they may expect.

There is a good deal of second year's indigo (called munda), and this is a more valuable crop than first year's indigo, and requires water by the end of April or early in May.

Should the supply in the canals fail or be inadequate before the end of September, the cotton and rice will suffer and the rabi area—the maturing of which is dependent entirely on wells or rain will be restricted.

16. Q. Owing to the uncertainty of the supply in the Siddnaji in some years, and the small amount of rainfall

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and its uncertainty, the maturing of rabi crop on the Sidhni system is largely depended on wells and the more there are the better.

Similarly on the Inundation Canals the rabi crop is solely depended on wells (or rain) for its maturing.

16. Q. It would be difficult to give a reply to this question. As for the normal value of the produce on the canal irrigated land is given by the Settlement Collector in his Assessment Reports (settlement just concluded) as somewhat less than that on wells (alone) and sailaba lands (lands irrigated by inundation from the river).

Thus in the Kabirwala Tehsil and Sidhni Assessment Circle (see * plan) the yields per acre in seers for various crops is as stated below :—

Class of cultivation.	Crops.	Yield in seers per acre.	Value per acre.
			Rs.
Ohahi or puro well.	Cotton .	180	18
	Juar .	Not grown	...
	Wheat .	340	16
	Barley .	340	12
Ohahi-Nahri or canal supplemented by wells.	Cotton .	180	18
	Juar .	Not grown	...
	Wheat .	440	21
	Barley .	440	15
Nahri or canal irrigation.	Cotton .	160	16
	Juar .	240	9
	Wheat .	340	15
	Barley .	340	12
Sailaba or irrigation from river inundation either puro or supplemented by wells.	Cotton .	120	12
	Juar .	200	9-6
	Wheat .	320-400	15-19
	Barley .	320-400	11-14

These statistics are based on the averages of large areas for a term of five years ending 1897-98. The only year of real drought which we have had on the Sidhni was the year 1899-1900, and for that year the statistics of yield and value are not given. All that can be said is that the output per acre on the Sidhni system was very bad, but that it was probably equally so on the lands irrigated by wells and river inundation.

Similar figures could be given for the area on the Inundation Canals, but I should say that a year of drought does not affect the value of the produce on these canals to the same extent, as such a year affects the produce on the Sidhni.

17. Q. (1) (a) On the Sidhni system from 1900-1901, inclusive the occupier's rate has been increased, and the average rate can only be given for that year.

It amounts to :—

2-64 for kharif,
2-82 for rabi,
2-74 for the year.

This is taken on the not-areen cultivated, i.e., after deducting for areas not properly matured (kharabu).

(2) (a). In this district, so far at any rate as these replies are concerned, cash rents are very rare. Batai, or share of produce, is practically universal, and may be taken generally speaking as at half the produce. For the Kabirwala, Multan and Shujabad Tehsils the figures as given by the Settlement Collector in Assessment Reports are :—

	Kabirwala.	Multan.	Shujabad.
Percentage of area cultivated by owners.	27-0	24	35
Percentage of area by tenants free of rent.	0-1	1	...
Percentage of area cultivated by occupancy tenants.	0-5	4	3
Percentage of area cultivated by tenants-at-will.	71-5	71	62
Total .	100	100	100
Percentage of area cultivated by tenants-at-will paying batai.	96	88	82

In Kabirwala Tehsil the ordinary batai rate is a half, 37 per cent. of those who pay batai give a half share. Multan Tehsil the average rate is 36-8 per cent. and Shujabad Tehsil, the average rate is 39 per cent.

For further details reference must be made to the Assessment Reports as the matter is too complicated to deal with here.

(3) (a). A statement is given attached of all the revenue and water advantage rates in this district in the three tehsils to which these replies refer, and the method of assessment is given in the statements. These are taken from the Settlement Collector's Assessment Reports.

(4) (a). Royalty is not paid or proposed as there are now no private canals in the three tehsils to which these replies refer.

(1) (b). On the Inundation Canals the occupier's rate was introduced for the first time from 1900-1901 so that the average rate can only be given for that year and amounts to :—

Rs.
1-73 for kharif,
0-88 for Rabi, nad
1-20 for whole year.

It was only introduced that year for some of the canals and has since in 1901-02 been extended to the remainder.

On the Inundation Canals the replies to (2) (b), (3) (b) and (4) (b) of this question are the same as given above for Sidhni system.

18. Q. On the Sidhni Canal and one of the subsidiary canals (Abdul Hakim) the cost of construction of minors was charged to the new settlers. For reasons, which need not be given here, the minors on the other two subsidiary canals, Fazilshah and Koranga, were built by Government. Originally the maintenance of all these minors fell on the cultivators generally (i.e., including the aborigines or men in the pre-existing villages), but five years ago the Government took over the maintenance of the minors on Fazilshah and Koranga. Thus the new settlers had to pay for the original cost of minors on the Sidhni and Abdul Hakim and the cultivators generally have still to clear the minors and keep them in order on these two canals.

I cannot state what the incidence of the original cost of the minors is per acre but I believe it is about 12 annas per acre, and the cost of clearing minors and keeping them in repair is very small.

It may be explained here that a large proportion of the land irrigated by the Sidhni and the subsidiaries was, before the canals were made, Government waste. This land was let out to settlers. The rest of the land was already partly inhabited and belonged to pre-existing villages.

Other expenditure which has to be incurred in bringing water to the land is in respect of digging the field water-courses, upkeep of bullocks for ploughing, erection of farm houses on new lands, cost of pipes and ultimately of masonry heads and culverts under pre-existing roads. To these should be added the cost of sinking a well, which though not absolutely necessary, is extremely advisable.

In respect of preparing the fields for irrigation I should say the only further expenditure required is on account of purchase of seed if this item may be included in this expenditure. Most of this expenditure falls on the land-owners.

Certainly all the expenditure in respect of cost of minors, water-courses, sinking wells, building habitations, outlet heads, culverts fall on the land-owners.

To what extent the tenant is responsible for the cost of upkeep of bullocks and for the purchase of seed I cannot exactly state, nor can I say how far he has any security for recoupment.

On the Inundation Canals the main item of expenditure is the cost of the clearance of watercourses which are very heavy in some places, but very light in others. The cost depends, of course, on what length the channel may be. The original cost of the existing watercourses, most of which are very old, perhaps in some cases three-fourths of a century or even a century old, was undoubtedly borne by the cultivators. The then Government merely dug the main canals. Any new watercourses which may be required are dug by the cultivators who would have to pay for the cost of the masonry heads now required for each and every watercourse. In preparing the land for irrigation the same items of expenditure are incurred, as given above for the Sidhni.

On the Inundation Canals there are fewer wells to provide, as there are and have existed, for many years, a very considerable number of wells on the land irrigated by these canals.

I fancy that the cost is borne by the land-owners to the same extent as on the Sidhnai.

The cost of making masonry heads or putting in pipes to existing water-courses falls on the Government.

19. Q. I think it may safely be said that no such damage has resulted. In regard to water logging, the Sidhnai Canal has only been in use for about 14 or 15 years, and in many years has not been in flow all the year round. The water level is still considerably below the surface and as far as one can see, the channels of water logging are remote.

On the Inundation Canals the water level, even near the river, is still at a considerable depth below the soil, though it certainly rises in the flowing season, falling off in the cold weather months. With their large supplies, it is probable that if the Inundation Canals were perennial, there would be a chance of the soil becoming water logged, but it is presumed that were these canals given a supply by means of a weir, so that they could flow for eight or nine months in the year instead of for six months, the supply in each canal would be reduced to what it is, say, on the Sidhnai. While 5 caseses per square mile are allowed on the Inundation Canals, half that amount suffices on the Sidhnai.

20. Q. The maintenance, except in the case of the minors on Faridkhan and Koranga mentioned above, is carried out departmentally by contract. The old ehber system, by which the cultivators on the Inundation Canals provided the necessary labour in lieu of paying a water rate, has now been finally abolished on the Multan canals.

According to a statement prepared in the Chief Engineer's office and issued with the notes on Punjab irrigation works for the Irrigation Commission, statement XVI—F, the rate per acre of working expenses on the Sidhnai system amounts, on the average of ten years ending 1900-1901, to '098. Re. exclusive of the year 1899-1900, when there was a complete failure of crops on the Sidhnai Canal system, and this rate amounted to Re. 5-15 per acre, the average rate for nine other years of this ten years' period comes to Re. 0-83 per acre.

The ehber system has only this year been abolished on all canals and for the first time last year (1900-1901) on any of the Multan Inundation Canals, so that it could not be possible yet to give the figures for these canals for any year. It was intended, when the water rate was introduced on these canals, that the revenue from the water rate should just balance the expenditure as arrived at from a consideration of the work previously done by the ehber system, which is tantamount to saying that the incidence of cost for maintenance per acre would equal the water rate. By improving the heads and channels generally and with better working of the canals this expenditure will undoubtedly be reduced in a few years, but it would not be possible to say what it will amount to.

A great reduction in the cost of maintenance follows from the reduction of heads for canals. Four years ago there were six heads—there are four now, and one of these will probably shortly disappear, the irrigation of the canal being entirely taken up by the Sidhnai, as from next kharif it will be partially taken up by that canal.

The system of maintenance is perfectly satisfactory, and no legislation is required in regard to it.

21. and 22. Q. Actually in use at present, there are no private canals in this district. From the Chenab River south of Multan there were, three years ago, two private canals similar to, but smaller than, our Inundation Canals. In past years they may have worked well, but our experience here is that small channels do not work well as Inundation Canals, and when I saw these two private canals in 1893 (June or July), they had not, as far as I could see, been cleared. The Government had a small inundation canal whose head was close to one of these two private canals (the lower one), and in 1899 it was decided to extend an upper inundation canal to take up this Government channel. This was done and after some hesitation on the part of the owners of the private canals, these latter were made watercourses from the extension, by which of course they were materially benefited, as the level in supply was much raised.

North of Multan and about 25 to 30 miles above the Government canals of the Sidhnai system is the Parkat Ali Khan canal which gave considerable trouble to its owner and is stated in the Settlement Collector's Assessment

Report of the Kabirwala Tehsil (page 41) to "have irrigated an average of 216 acres of matured crops on the average of five years" (ending 1897-1898). The question of this canal, which was taken over by Government was settled practically before I joined the Division. Government (not the Irrigation Branch I believe), bought it in 1893 and abandoned it as useless in 1897. It flowed (according to Settlement Collector's Assessment Report, Kabirwala Tehsil, page 45) for "14 days in 1895—3 days in 1896 and 33 in 1897."

It is on a side long gradient and in case of rain gets washed away, or at any rate seriously damaged. A drainage cut was made above it, but I believe proved ineffectual. The canal always heavily silted at its head.

There is no scope for private canals here.

There are on the Ravi numerous short cuts from the river, but these are hardly canals. They work, I believe, well. They are prevented from taking too much water by having had masonry diaphragms built near their heads at a certain fixed level and any new cuts—there has only one, I think, been made during the last four years—would be given on condition of such a diaphragm being built.

E.—Wells.

34. Q. The accompanying statement gives the information required for (1), (ii), and (7), taken from Settlement Collector's Assessment Reports. The circles are the same as in these reports, as the information is taken therefrom.

Hittar is the land adjoining the river and mainly subject to inundation.

Tarafa are the land round about Multan.

Uttar is the land not far from the rivers, but not subject to inundation, being higher than the Hittar.

Rawa is the high "bar" land away from the river where the cultivation, if any, is almost entirely dependent on wells (or rainfall, if any).

Sidhnai is the land on the Sidhnai system of canals mainly—but its boundaries extend a little beyond the present canal limits on the Chenab River side.

Wells are used either alone or to supplement canal irrigation or Salaba (river inundation irrigation). The former are mainly in Tarafa, Uttar and Sidhnai, and the latter in Hittar Circle. Those in Hittar, Sidhnai, Uttar and Tarafa are undoubtedly supplied by percolation. As regards those in Rawa, I cannot say for certain. Wells not far from the river do not fail if cleared out periodically. The further the wells are away from the river the more they are likely to fail in dry seasons and the deeper is the well. I cannot say on what information the Settlement Collector bases the results given, which are tabulated in the statement as regards the depths of wells, whether the depth is to water surface in the cold weather or in the flood season. For wells near the river, there is a considerable difference between the two.

Even for wells close together, and the wells in each group are never more than a few hundred feet apart, there is a very considerable variation in the depths to the water surface and the depth of water in the well.

35. Q. No further information can be given on this point beyond that which has already been given in reply to Question 13.

36. Q. Acre for acre of crops grown, there appears to be little or no difference in the yield on lands watered by wells and on lands which have no wells and which depend on rainfall, but there are few crops and these only to a very limited extent grown on land without wells and dependent on rainfall only (barani lands).

Thus for the whole of the 3 tehsils the area of barani cropped for 1897-98 was—

Tehsil.	Area of barani acres.	Percentage of whole cropped area.
Kabirwala . . .	360	0.19
Multan . . .	1,000	0.50
Shujabad . . .	Nil.	Nil.
TOTAL . . .	1,360	0.36

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So that wherever crops are grown by means of wells on land not otherwise irrigated the value of the produce so grown is attributable to wells.

Comparing chahi and barani for five crops in the Kabirwala Tehsil for the five assessment circles already mentioned,

the following results are obtained on the average of five years ending 1897-98 from assessment report of Kabirwala Tehsil:—

Assessment Circle.	Crops.	Class of cultivation.	Value in rupees per acre.	Remarks.
Hithar Chenab	Cotton	Barani	Nil	The only crop grown on Barani is til, value per acre Rs. 8. Til on chahi, value Rs. 10 per acre.
		Chahi	18	
	Jowar	Barani	Nil	
		Chahi	9 6	
	Wheat	Barani	Nil	
		Chahi	15	
	Barley	Barani	Nil	
		Chahi	11	
	Bajra	Barani	Nil	
		Chahi	11	
Hithar Ravi	Cotton	Barani	12	Value of til per acre, Rs. 8 in each case.
		Chahi	18	
	Jowar	Barani	Nil	
		Chahi	9 6	
	Wheat	Barani	12 1	
		Chahi	19	
	Barley	Barani	9	
		Chahi	10 1	
	Bajra	Barani	Nil	
		Chahi	11	
Uttar	Cotton	Barani	Nil	Ditto.
		Chahi	18	
	Jowar	Barani	Nil	
		Chahi	Nil	
	Wheat	Barani	12 4	
		Chahi	19	
	Barley	Barani	Nil	
		Chahi	10 1	
	Bajra	Barani	10	
		Chahi	Nil	
Rawah	Cotton	Barani	8	Ditto.
		Chahi	18	
	Jowar	Barani	Nil	
		Chahi	12 4	
	Wheat	Barani	15	
		Chahi	Nil	
	Barley	Barani	11	
		Chahi	10	
	Bajra	Barani	11	
		Chahi	8	
Sidhnai	Cotton	Barani	18	Value of til Rs. 8 per acre, barani Rs. 15 per acre, chahi.
		Chahi	6	
	Jowar	Barani	Nil	
		Chahi	12 1	
	Wheat	Barani	16	
		Chahi	9	
	Barley	Barani	13	
		Chahi	10	
	Bajra	Barani	11	
		Chahi	11	

For a year of drought as 1899-1900 there are no figures available.

37. Q. For reply to the first part of this question see reply to Question 17 (2) (a) above. The cultivator, where he is not the owner, pays in most cases "batal" or share of actual produce in each crop.

For reply to second part of the question, see statement* attached, which also gives the information as to how the rates are paid.

38. Q. I should say that no difficulty is met with in finding water or in the construction of a well, at any rate in the Hithar, Tarafa, Sidhnai and Uttar Circles. Of the Rawah I have no information. I think the reply to the second part of the question as to assistance with advice or tool is certainly no.

39. Q. I think that Government might, with advantage, sink wells on private land on the Sidhnai. As stated above the maturing of the rabi crop on the Sidhnai is in many years entirely dependant on wells.

In the Kabirwala Tehsil to the end of 1897-1898 according to the Assessment Report of the Settlement Collector (Appendix, page XXXV) there were in Sidhnai Circle 1,786 wells in use and 276 out of use. This shows a very small

increase of 630 wells in use (and 10 out of use) since the year of the previous Settlement 1877-78 and the increase in wells in use is not commensurate with the increase in irrigation. The total area of cultivated lands in 1877-78 was 44,711 acres and now is 176,941. Thus there were, in 1877-78, 16 wells in use per square mile of cultivated area and six wells in use now per mile, square mile of cultivated area. When any land is or has been let out on lease on the Sidhnai, a special clause of the agreement with the lessee is to the effect, that the rate for rabi shall be only Rs. 1-12 per acre for land irrigated partly by canal and partly by well, for a period of 20 years from the sinking of the well from which the well water is derived. This means that Rs. 1 per acre per year, is granted for 20 years as an inducement to sink a well on land which grows a crop by aid of well water in rabi. Taking the average area cultivated by a well in Sidhnai as 15 acres (Kabirwala Assessment Report, page 52), each well obtains on the average Rs. 15, reduction in assessment per year for 20 years.

The Sidhnai canal has not been in flow for 20 years, but only 14-15, so that it is impossible to say in how many years out of 20 it would be necessary to mature rabi crops by the aid of well water, but for the last ten years, up to and of 1900-1901, the following statement shows that in seven years, out of the ten, well water was entirely dependant

on to irrigate rabi crops. The rabi season begins from 1st October to end of 31st March :—

Years.	Number of days Sidhni was in flow in rabi.	Year.	Number of days in flow.
1891-92 .	27	1896-97 .	25
1892-93 .	100	1897-98 .	27
1893-94 .	111	1898-99 .	7
1894-95 .	64	1899-1900 .	277.
1895-96 .	33	1900-1901 .	118

Probably this is more than the average on the term of 20 years and the number of years that rabi would have to be matured by well water may be taken as 11 out of 20 years. So that there is a loss of revenue, or rather a rebate of revenue of Rs. 165 per well. In addition to

that it must be remembered that every well sunk adds to the rabi crop matured in a like number of years and helps in some other years. Altogether the Government would recover the cost of each well sunk.

Difficulties no doubt would arise. It would be impossible to give each lessee on the Sidhni a well as the holdings are small and the holdings would have to be grouped together in some cases.

If the zamindars were able to sink wells themselves, it would be preferable to adhere to the present arrangement but, as it appears that, being mostly men of small means, they are unable to find the necessary capital and are probably reluctant to take "talavi" advances or borrow money, the proposal to sink wells by Government Agency seems one that might be considered, I believe this is done on the Upper Sutlej canals.

On the Inundation Canals I do not think there is any present need for Government to sink wells. Wells are much more numerous on these canals than on the Sidhni and in many cases there are as many wells as are required.

40. If there are any temporary wells in this District, so far as that portion on the Multan canals is concerned, there are very few and they are probably confined to the Hithar Circle.

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Statement showing period, number of days canals were in flow from 1st April to 31st March.
Q. 12 (S.)

CANALS.	AMPLE RAINFALL.			SCARC RAINFALL.			DROUGHT.			Average number of days in flow for last 10 years ending 31st March 1901.	REMARKS.
	1893-1894.			1893-1899.			1893-1900.				
	Date of opening.	Date of closing.	Number of days in flow.	Date of opening.	Date of closing.	Number of days in flow.	Date of opening.	Date of closing.	Number of days in flow.		
SIDDHAI CANAL SERIES.											
Sidhmāi	1st April	26th March .	345	25th April (b).	22nd October	109	18th May .	19th September	114	213	(c) Exclusive of any days on which closed to pass floods or for branches. (a) Early closing due to drought. Late opening due to late melting or failure of snowfall. (b) Only open for a few days and again failed.
Fazilshah	1st "	23rd "	253	18th July	3rd "	68	10th "	17th "	87	137	
Koranga	4th "	18th "	230	18th "	3rd "	69	19th "	16th "	88	128	
Abdul Hakim	1st "	26th "	235	18th "	3rd "	71	19th "	16th "	88	130	
CHUNAB CANAL SERIES.											
Natti-thol	4th April	19th August .	153	1st May .	23rd September	146	26th April .	29th August .	117	143	Worked from one head since 1896-1897 inclusive.
Wali Mohammad	8th "	11th October .	188	5th "	23rd October .	150	27th "	24th September	123	157	
Daurana Langana	25th "	14th "	173	5th "	23rd "	150	27th "	24th "	121	185	
Sikandrabad	16th "	5th "	185	3rd "	27th September	147	28th "	2nd October .	159	163	Worked from one head since 1893-1900 inclusive.
Gajjuhatia	17th "	15th "	181	27th April .	23rd "	151	1st May .	5th September	126	154	
Farjami	23rd "	8th "	167	8th May .	21st "	119	28th April .	29th August .	103	141	
Sikandarwah	23th "	3rd "	153	5th "	24th "	131	12th May .	5th September	116	137	Ditto ditto.
Belochanwah	12th May	11th "	153	5th "	22nd "	116	12th "	5th "	116	134	

CROP RATES FOR CANAL IRRIGATED LANDS.

(From Assessment Reports.)

Question 17 (3).

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	Class of cultivation.	Name of Canal.	KABIRWALA TEHSIL.			MULTAN TEHSIL.					SHUJABAD TEHSIL.		
			ASSESSMENT CIRCLES.			ASSESSMENT CIRCLES.					ASSESSMENT CIRCLES.		
			Ilithar.	Uttar.	Sidhnai.	Ilithar.	Tarafa.	Uttar.	Rawa.	Sidhnai.	Ilithar.	Uttar.	Rawa.
			R a. p.	R a. p.	R a. p.	R a. p.	R a. p.	R a. p.	R a. p.	R a. p.	R a. p.	R a. p.	R a. p.
Fixed (a)	Chahi . .	Inundation Canals.	0 0 0	...	0 0 0	1 4 0	1 8 0	0 14 0	0 10 0	0 14 0	1 12 0	1 8 0	1 0 0
	Nahri . .	Sidhnai .	...	0 0 0	0 8 0	...	...	...	...	0 8 0	...	...	...
Fluctuating (b)	Nahri and Chahi Nahri	Inundation Canals.	1 4 0	...	1 4 0	1 4 0	1 4 0	1 4 0	1 4 0	1 4 0	1 4 0	1 4 0	1 4 0
	Canal advantage rate.	Sidhnai .	...	2 12 0	2 12 0	...	...	...	...	I class 3 2 0 II class 2 0 0	...	...	...

(a) Is fixed and taken on the average area of crops harvested for five years ending 1907-08.

(b) Is taken on the yearly areas harvested.

For Assessment Circles see reply to Question 34 below.

For class I and II, Sidhnai, Multan Tehsil, see crop rates for well lands.

List of Wells, Multan District, Multan Canals. Q. 34 (1), (6) and (7).

Tehsil.		ASSESSMENT CIRCLES.					Total or average.
		Ilithar.	Tarafa.	Uttar.	Rawa.	Sidhnai.	
Kabirwala.	Number of wells in use or fit for use . . .	204 C 338 R	...	643	350	2,062	3,547
	Average depth of well to water . . . feet	13 C 26 R	...	27	30	26	24
	Average area of well cultivation per well in use .	20 C 10 R	...	14	14	15	15
	Average culturable area on wells . . .	75 C 30 R	...	21	16	85	45
Multan.	Number of wells in use or fit for use . . .	1,384	751	1,483	259	734	4,611
	Average depth of well to water . . . feet	12	21	19	38	34	26
	Average area of well cultivation per well in use .	23	12*	25	16	10	19
	Average culturable area on wells . . .	44	10*	48	36	104	48
Shujabad.	Number of wells in use or fit for use . . .	1,040	...	1,730	755	...	4,425
	Average depth of well to water . . . feet	12	...	15	22	...	16
	Average area of well cultivation per well in use .	16	...	21	19	...	19
	Average culturable area on wells . . .	40	...	33	36	...	36

* Double cropping.

Kabirwala, Ilithar divided into Chenab (C) and Ravi (R).

Major
Morton,
R.E.

CROP RATES FOR WELL LANDS.

QUESTION 87 (2).

(From Assessment Reports.)

Tahsil.		KADINWALA.						MURTA.						SARVAD.			
Assessment circle.		Hithar Chenab.	Hithar Ravli.	Uthar.	Rawa.	Sidhnai.	Hithar.	Tarni.	Uthar.	Rawa.	Sidhnai.	Hithar.	Uthar.	Rawa.			
	Chahi	Rs. a. 1 6	Rs. a. 1 2	Rs. a. 1 0	Rs. a. 1 0	Rs. a. 1 6	Rs. a. 1 6	Rs. a. 1 8	Rs. a. 1 0	Rs. a. 0 14	Rs. a. { 0 13* { 1 0†	Rs. a. { 1 12 { 1 12	Rs. a. 1 8	Rs. a. 1 0			
Fixed (see crop rates for canal lands).	Inundation Canals	0 6	...	...	...	0 6	1 4	1 8	0 14	0 10	0 14	1 12	1 8	1 0
	Chahi Nahri . . . . .	...	...	0 6	...	0 8	...	...	...	...	0 6	0 12	0 8	...
	Chahi Sallab	0 8	0 0	0 4	0 4	0 8	...	...	...	...	...	...	...	...
Fluctuating (see crop rates for canal lands).	Nahri with Chahi Nahri	1 4	...	...	...	1 4	1 4	1 4	1 4	1 4	1 4	1 4	1 4	1 4
	.....	...	...	2 12	...	2 12	...	...	...	...	3 2	...	...	...
	.....	...	...	...	...	...	...	...	...	...	2 0	.....	...	...
	Chahi Sallab—	1 8	1 4	1 4	1 4	1 8	2 0	...	...	...	Rs. a. Rs. a. 1 10—2 0	...	1 10	1 10
	Class I . . . . .	...	...	...	...	...	1 0	...	...	...	...	1 0	1 0	1 0

* On Sidhnai canal area.
† On other areas in Sidhnai circle.

Class I, Sidhnai comprises—
Cotton,
Til,
Sugarcane,
Chilies,
and Class II other crops.

Class I, Multan and Shujabad Tehsils, Chahi Sallab comprises—
Rice,
Fruit,
Vegetables,
Pepper.

and Class II other crops.

Tobacco.

(5) MR. J. J. MULLALLY, M.I.C.E., Saperintending Engineer, Western Jnma Circle.

N.B.—All the answers given below refer to the Delhi, Karnal, Rohtak and Hisar districts, where I acted as Saperintending Engineer of the Western Jnma Canal for six months.

7. The benefits of irrigation may be estimated as follows:—

- (a) In years of ample rainfall there is no appreciable difference between an irrigated and an unirrigated crop, but in years of scanty rainfall the produce is increased, at a low estimate, by 25 per cent., and in years of drought by 50 to 75 per cent. according to the defect in the rainfall.

If x , y and z represent the produce per acre of an unirrigated field, in years of ample, scanty and very scanty rainfall respectively, then the produce of an irrigated field would be represented by x , $y + \frac{y}{4}$ and $z + \frac{z}{2}$.

- (b) The increase in produce and the certainty of outturn enables and encourages the owner (or occupier, as the case may be) to spend more money on the seed and labour required for more valuable crops, and in this way even in a year of good rainfall, his income from the sale of the more valuable produce will certainly be 10 per cent. more than the income from low class irrigated crops.

In years of ample, scanty and very scanty rainfall the land, which has been under careful irrigation for some years, will therefore give an income of

$$x + \frac{x}{10} = 1\frac{1}{10}x \quad \frac{5y}{2} + \frac{5y}{10} = 3\frac{1}{2}y \quad \frac{3z}{2} + \frac{3z}{10} = 2\frac{3}{10}z$$

- (c) In the course of 20 years or so, having become rich enough to buy cattle, he is enabled to manure his land, and double crop it without exhausting it, and thus add certainly another 10 per cent. over and above the income due to the cultivation of high class crops.

Then the income will increase in the three typical years respectively to—

$$\left(1\frac{1}{10} + \frac{1}{10} \times \frac{1}{10}\right)x = \left(1\frac{1}{10} + \frac{1}{100}\right)x = 1\frac{11}{100}x = \text{say } 1\frac{1}{5}x$$

$$\left(3\frac{1}{2} + \frac{1}{10} \times 3\frac{1}{2}\right)y = 4\frac{1}{4}y = 4\frac{25}{100}y = \text{say } 4\frac{1}{4}y$$

$$\left(2\frac{3}{10} + \frac{1}{10} \times 2\frac{3}{10}\right)z = 2\frac{33}{100}z = 2\frac{33}{100}z = \text{say } 2\frac{1}{2}z$$

I therefore estimate that after say 20 years of careful irrigation in villages that are protected from water-logging an acre will return from 75 to 100 per cent. more profit in a year of drought, than it would have done even so means of irrigation provided.

In a year of scanty rainfall, the profit would be 50 per cent. more, and even in a year of ample rainfall, the profit would be 25 per cent. more than could be expected from an unirrigated field.

8. As I have been transferred to the Jhelum Canal Circle I regret I have no papers with me from which I could obtain the necessary figures.

9. The total sum received as water rates on the Western Jnma Canal from the cultivators of 601,820 acres during the year 1899-1900 amounted to Rs. 19,95,340, giving an occupier's or cultivator's rate of Rs. 3.02 per acre.

The total sum received in the same year as owners' rates on the same area was Rs. 8,90,135, giving an owner's rate of Rs. 1.35 per acre.

I have no notes by me to show the average annual rate per acre paid by the cultivator to the owner of the land in the form of enhancement of rent or otherwise.

The above rates are those paid on the area actually irrigated on the whole canal. I regret I have not access now to the papers necessary for calculating the averages separately for each district.

11. Much evil resulted both to the people and to the soil in the districts of Karnal and Delhi from injudicious

irrigation, some 20 to 30 years ago. The people suffered in health and the soil became water-logged, but much has been done of late years to remedy this state of affairs by draining the land and reducing the supply of water given to it. Even now, however, in large areas of these two districts, water is found at from 5 to 15 feet below the natural surface and the level of this water seems to be still slowly rising.

It is evident that we should draw on this natural reservoir which is close at hand, and which we have filled so full, by insisting on the construction of a much larger number of wells in these districts.

The following figures will be of interest in this connection:—

According to the Punjab Land Revenue Administration Report for 1899-1900, I find that in Karnal there were 10,000 wells on a total cultivated area of 1,101,752 acres or about 1 well to every 100 acres.

In Delhi I find that the figures give 1½ wells to every 100 acres whilst in Jullundur we have ¾ wells to every 100 acres.

Now wells can be worked to a profit when the subsoil water is 25 feet or less below the natural surface, and I think that wherever, in the canal commanded area, this condition exists, we should not rest satisfied until every 100 acres of cultivable land has three to four wells on it. Such a number of wells would protect the commanded areas completely, firstly, from famine in years of drought, and secondly, from water-logging in years of excessive rainfall.

It, therefore, appears to me that the prevention of famine in Hisar and Rohtak, and the protection of the districts of Delhi and Karnal from water-logging will depend firstly, on the restriction of the supply of canal water in surface watercourses, and secondly, on the encouragement given to villagers to replace this source of supply by wells.

There is one more point that I must refer to in this connection.

When the number of wells in the canal commanded area has increased to say 3½ in every 100 acres, the draw on the wells would lower the subsoil water level and I anticipate having then to supply canal water (perhaps through masonry channels) direct to the well in order to keep the supply in the well up to the level required for remunerative working.

39. In my answer to question 11, I have shown that it is necessary to restrict the supply of canal water given by means of surface watercourses to many parts of the Karnal and Delhi districts and to substitute for it the subsoil water received from wells; and I have shown that this is necessary for two reasons, viz., (1) to save water for the districts of Hisar and Rohtak, and

(2) to prevent water-logging in Karnal and Delhi.

It is, however, not likely that the villagers will go to the expense of sinking wells when they can get water so much more conveniently from the existing canal watercourses, and I, therefore, think it will be necessary on the one hand to bring considerable pressure to bear by restricting the supply of canal water very much more than it has been restricted, even of late, and on the other hand, to offer considerable assistance in the construction of the wells.

It is certain that even in the canal irrigated parts of the country, there will be many cultivators, who will never have sufficient money to sink a well and it is quite conceivable that it would be both politic and remunerative to sink wells under the supervision or even at the cost of Government in private lands, but in my opinion the time has not yet arrived for doing this in the tracts under consideration. So much can still be done in restricting canal supplies and in encouraging the construction of wells by private enterprise that I do not think that Government need interfere by itself constructing wells, for very many years to come.

Mr. J. J. Mullally,
M. I. C. E.

(6) MR. C. M. KING, Settlement Officer, Ferozpora.

A.—General.

1. The answers recorded below refer generally to the tract irrigated by the British Branches (Abohar and Bhatinda) of the Sirhind Canal and more particularly to the Ferozpora district and the Fazilka tahsil of that district.

I have been connected with the Ferozpora district since March 1896, first as Assistant Commissioner, then as

Deputy Commissioner and lastly as Settlement Officer of Fazilka. In 1901 I was put on special duty in connection with the proposed revision of the occupiers' rates on the Sirhind Canal, and in October and November of that year I toured up the Abohar Branch to the head of the Sirhind Canal and down the Bhatinda Branch to Bhatinda.

2. The following statement shows the mean average rainfall of the Ferozpora and Ludhiana districts for each

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season of the year. I have not been able to obtain the average figures for each month. The figures are extracted from the Revenue Report of the Irrigation Department for 1898-99.

District.	MEAN AVERAGE RAINFALL.			TOTAL.
	April to September.	October to December.	January to March.	
Ferozepore . . .	11.64	0.41	1.88	13.93
Ludhiana . . .	15.27	0.67	2.42	18.36

In the case of Ferozepore the mean is obtained from the observations recorded at nine observing stations, while in the case of Ludhiana the mean represents the observations recorded at four observing stations.

The actual variation in the average rainfall are much greater than that brought out by the above means. The average yearly rainfall at Akbara in the Ludhiana district is 24.32 inches, while that at Jandwala in the Fazilka tahsil is only 9.24 inches.

3. So far as I am aware there is no obstacle to the extension of irrigation in the Ferozepore district except the fact that the Sirhind Canal does not carry sufficient water to permit of further extensions. Moreover, it would be useless to increase the carrying capacity of the canal because, as it is, the canal absorbs all the water in the Sutlej above Rupar in the winter months. A glance at the rainfall figures will show that this is just the time when water is most required. Except in the low lands of Ferozepore (strips of land which run parallel to the Sutlej), irrigation from wells is quite unprofitable, the depth of water being too great. The low lands are sufficiently protected against drought already, and I do not think that any further extension of irrigation in these parts is necessary. I must make an exception in the case of the Hithar circle of the Muktsar tahsil, and the Uttar circle of the Fazilka tahsil. Irrigation from wells in these circles is difficult, but irrigation from irrigation canals is feasible, and I think that this kind of irrigation can be extended.

I have made no mention of the belt of dry land in the Moga tahsil between the areas commanded by the present Inundation Canals and the Sirhind Canal, because I am informed that a scheme is under consideration to dig an inundation canal to irrigate this belt. When this canal is completed the only areas to which irrigation can be extended will be those mentioned above.

To sum up irrigation has been extended in the Ferozepore district almost as much as is necessary or possible.

4. In the case of wells there is a rule by which lands are assessed at dry rates for a period of 20 years from the date of the construction of the well. The exemption is secured in practice by giving to the maker of a well a patent or lease for 20 years which ensures that his land is assessed at dry rates for that period. This rule does not apply in the case of land under fluctuating assessment. In such cases the maker of a well gets no special advantages.

I only know of one case where land irrigated by a private canal was partially exempted from enhancement of assessment. This was in the case of the Fazilwanh Canal which was constructed by the landowners of the Hithar Circle of the Fazilka tahsil under the direction of Colonel Grey. In this case the land was mostly under fluctuating assessment and Government ordered that for a period of ten (10) years only half irrigated rates should be charged for land irrigated by the canal which at settlement had been recorded as *barani* or *baigar*.

I do not think that any similar exemption from enhancement of rent is extended to tenants, but I think the latter are sufficiently protected by the provisions of the Tenancy Act, which prevents the ejection of a tenant till he has received compensation for all improvements he has made on his tenancy (section 18). I consider that the existing provisions in respect of exemption from enhancement of revenue and rent are sufficiently liberal.

5. Loans under the Land Improvement Act are not taken as freely as they might be.

6. I attribute this to the cumbersome procedure necessary for the grant of these loans. This procedure is necessary in most cases in order to prevent fraud, but at the same time it frequently results in hardship to the borrower.

For example, supposing a zamindar wants a loan, he has first to go to the Sirdar and get a petition written asking for the loan; unless he happens to be known to the Deputy Commissioner personally, the petition is referred back to the Tahsildar, who again probably refers it to the Kanungo who will go to the village and make the necessary inquiries. The Tahsildar then submits his report to the Deputy Commissioner and the loan is granted. Thus there is considerable delay, and wherever the borrower has to deal with an underling he must be prepared to tender a *douceur* proportionate to the amount of his loan. Thus it is that the man who has any credit with his *bania* much prefers to get his loan from him. It is only the man without credit who, as a rule, comes to Government for a loan.

The only suggestion I can make is that Deputy Commissioners should attend to the matter of giving loans when they are in camp, and they should always carry about with them enough money for this purpose. Then the Deputy Commissioner being on the spot could at once decide if a loan ought to be given or not without having to refer to the Tahsildar or any one else. The money could be paid to the applicant at once and the latter instead of having to wait five weeks or more for his loan could get it in as many minutes. I fear, however, that this is a counsel of perfection. Deputy Commissioners have, as a rule, far too much work to do now-a-days to permit of their devoting as much attention as I advocate to this single branch of their duties. There is no reason, however, why the power to distribute loans in this way should not be given to Assistant and Extra Assistant Commissioners and even to a few selected Tahsildars. I am convinced that, as a rule, the people are too lethargic and fatalistic to come for loans, but they will eagerly take up loans if they can get them without leaving their villages.

I consider that the present rate of interest is quite low enough. In times of drought or when a crop has been destroyed owing to natural calamity, I think that the interest should be suspended or remitted. I do not think there is any necessity for grants-in-aid in Ferozepore. The people are fully alive to the benefits of irrigation whether from wells or canals, and they do not require the inducement of a grant-in-aid to make them dig either.

6. My experience is that the extension of irrigation does not tend to injure the remaining cultivation by attracting its cultivators to the irrigated tracts. As I have had to deal only with a district, practically the whole of which is irrigated, my experience on this point is not worth much.

There is a very strong desire among the people to have the means of irrigation extended and increased.

B.—Canals of continuous flow.

7. In the Ludhiana, Jagraon and part of the Moga tahsils it is usual now to sow gram immediately after Juddu corn. Formerly the same land could only produce two crops in two years (one kharif followed by two fallows and then a rabi).

The degree to which more valuable crops are being substituted for less valuable crops is best illustrated in the case of the Rohi circle of the Fazilka tahsil. In 1880-1881 (i.e., at the time of the last settlement), the whole circle which consists of 206 villages, was entirely dependent on the local rainfall which was very precarious. The output of each crop was estimated by Mr. Wilson to be as follows:—

Crop.	Output in thousands of maunds.
Jawar	147
Bajra	437
Muth	10
Mung	10
Til	22
Wheat	15
Barley	262
Gram	94
Sarshaf	3

The outturn as now estimated is as follows:—

Crop.	Outturn in thousands of mannds.
Maize	13
Jawar	104
Bajra	185
Moth	42
Mang	2
Til	8
Cotton	17
Wheat	418
Barley	197
Gram	559
Saralaf	139
Taramira	8

These tables show how wheat, gram and saralaf have taken the place of bajra, barley and jawar as the principal staples of the tract.

Mr. Wilson estimated the value of the total outturn at Rs. 9,20,000. The value of the outturn as estimated by Mr. Wilson would at present prices have been Rs. 14,04,000. The value of the outturn now is estimated by me to be Rs. 28,46,000. The difference between these two figures is almost entirely due to the Sirhind Canal. Of course a part of the difference is due to the fact that more land has been brought under cultivation, but this increase in cultivation is almost directly attributable to the canal. The principal factor in the increased value of the outturn is the fact that valuable crops like wheat and saralaf are taking the place of less valuable crops such as jawar and barley.

In Ludhiana and parts of Moga the same thing has happened. There Indian corn and sugarcane are being grown to an increasing extent, and wherever Indian corn is grown it is followed by gram.

So far as I have been able to ascertain, in a year of ample rainfall, there is not much difference between a canal irrigated crop and a *barani* crop. This is especially the case in Ludhiana and Moga. Indeed, in these tracts the *barani* rabi of 1901 was in many cases superior to the *nahri*. The reason of this was that the *barani* land had perforce lain fallow for three or four harvests, and when the rain came the land was much more fruitful than the *nahri* land of which a crop had been taken regularly every year. In Fazilka and parts of Muktsar tahsil the rainfall can seldom be described as ample, even if it happens to be above the normal. In these parts, therefore, the *nahri* crops are almost invariably better than the *barani*.

It is curious that *jawar* and *bajra*, when canal irrigated, do not produce a good outturn of grain. I am unable to give a reason for this, but I believe it is a fact. In years of scanty rainfall and in years of drought there is no question as to the advantage conferred by the canal. In such years there is hardly ever any crop except that which is canal irrigated.

8. I have figures available for Fazilka tahsil only. In the case of the Rohi circle of that tahsil I calculated that on an average an acre of canal irrigated crop was worth Rs. 11-8-0, while an acre of *barani* crop was worth Rs. 6-8-0. In a year of drought I should say that the acre of *nahri* crop would be worth much the same as it is in a normal year, while the value of the *barani* crop would be nil, because there would be none. It may seem strange that the value of the *nahri* crop should remain constant, but the explanation is that though the outturn per acre is less yet the increase in price gives the cultivator much the same return in cash. Of course, if the drought is not general, there would be no increase in price. In that case I should estimate the value of the *nahri* crop at about Rs. 9 or Rs. 10.

9. (1) The average rate paid as occupier's rate on the Sirhind Canal was in 1897-98 Rs. 3-30 per acre and in 1898-99 Rs. 3-43 per acre. These are the latest figures to which I have access.

(2) As a rule the tenant pays the owner a rent in kind which is a certain fixed share of the produce. In the

Punjab.

Fazilka tahsil the average rent rate in the case of *nahri* crops is 25 and in the case of *barani* crops 26. Applying these figures to the values worked out in paragraph 8 we see that the average cash equivalent per acre in the case of *nahri* land is 25×11½ or Rs. 2-88 per acre and in the case of *barani* land 26×6½ or Rs. 1-43 per acre. Thus the enhanced rent paid by the tenant is Rs. 1-45. As a matter of fact, however, the enhancement is greater than this because the introduction of canal irrigation has resulted in a general rise of rents. At last settlement the usual *batai* rent rates for *barani* land were ¼ or ½. They now exceed ½.

(3) Hitherto the owner has reaped all the benefit from the introduction of canal irrigation. Proposals are now being made to take some of the owners' profits, either by increasing the occupiers' rates and thus compelling the owner to reduce his rent rate or by imposing an increased land revenue rate on canal irrigated land. So far nothing has been decided as to the form of the proposed rate.

10. In Fazilka, with very rare exceptions, the tenant prepares his holding for irrigation. The expense is very small indeed. A few minutes' work suffice to clear out a channel which has got silted up.

11. All the inquiries I have made are conducive in showing that the outturn of the crops grown on canal irrigated land is not as great now as it was when irrigation was first extended to the tract. The people say the land has grown old, and lost its *tahat*. What has happened is that the land has been overcropped. Year after year a crop of wheat or saralaf is taken from a field, and frequently a *kharij* crop is taken as well. The use of manure is known, but owing to the scarcity of manure it is rare. The people (in Fazilka at least) seem to have an idea of the value of the rotation of crops, and consequently the outturn of the fields is decreasing year by year. In former days fields were allowed to lie fallow, but with the increasing pressure of population cultivators are getting more and more averse to allowing their fields to lie fallow. Another reason why the cultivator cultivates as much land as possible is to be found in what I think are certain defects of canal administration. When canal irrigation was first introduced the people were encouraged to take canal water as much as possible. As a part of this system of encouragement the *wāris* or irrigation turns, were fixed not with reference to the area held by a man but with reference to the area irrigated. Thus if A held 40 acres of irrigable land and B 20 acres and if each irrigated 20 acres their *wāris* would be equal. The result was that A irrigated as much of his land as possible, so that he might have a longer turn than B. A part of his crop A would give only one watering to, while he would mature the more valuable part with three, four or five waterings, which his increased *wāris* enabled him to give. I consider this system a bad one. It leads men to irrigate more crops than they will be able to mature with the aid of canal water alone, and it also leads them to irrigate much more land than they have water for. I am of opinion that the *wāris* should be fixed once in four years with reference to the cultivated canal irrigated land in a man's possession. I would define that land as canal irrigated which had received canal water from an authorized watercourse at least once in the preceding four harvests. These *wāris* would be fixed for a period of four years, and a list of *wāris* would be filed with each detailed *jāmadāndi*. I consider that the effect of such a system of *wāris* would be this:—The cultivator would no longer have any inducement to irrigate more land than could be irrigated profitably, because whatever the area he irrigated, the length of *wāris* would be exactly the same. At the same time he would have some inducement not to irrigate the same field over and over again, because if he did so the area which would be classed as irrigated would be less than if he employed some sort of rotation, and thus when the *wāris* came to be fixed again at the end of four years, his *wāris* would be smaller than it might be. To this system of *wāris* it might be objected that the large cultivator might, in years of drought, be able to sell his turn or a portion of his turn to the smaller cultivator. If any such sales took place I should think they could be prevented by prosecutions under the Canal Act. When water is given to a cultivator, it is given him for the cultivation of certain land which is in his possession. If he diverts it to other land, he is surely liable to punishment for the improper use of canal water.

Along with this system of fixed *wāris*, I would introduce a new *khārāba* system. On the Sirhind Canal the canal officers endeavour to irrigate each year a certain proportion of the irrigable area. This proportion varies in various villages. The average for the whole of the Fazilka tahsil is, I believe, 33 per cent. I would let it be known among the people that Government was prepared to irrigate each

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year only one-third of the irrigable area. If a cultivator cultivated less than this, and his crop fell below the average owing to the insufficient supply of canal water, drought, or any other cause, I would give him a liberal remission for the estimated failed area. If, however, the cultivator chose to irrigate more than the one-third, I would let him know that he did so at his own risk entirely and must pay full rates for the whole area irrigated, whether there was a crop or not.

To give an example of my proposals:—

Suppose A is self-cultivating owner, holding 40 acres of canal irrigated land. The area he can profitably irrigate according to the calculations of the Canal Department is one-third, and he therefore irrigates 6 acres in the kharif and 8·33 acres in the rabi. If he irrigates as much and no more he will be entitled to liberal khata allowance if his crop falls below the normal. If, however, he irrigates 16 or 20 acres he will get no allowance for kharaba at all, no matter how bad his crop may be. I think that in such a case with fixed rates the prudent cultivator would have every inducement to irrigate not more than 18·33 acres. At the same time he would have every inducement to change the field irrigated every year so that at the end of the four years when the rates will be fixed again he may have as much land recorded as irrigated as possible.

There has been no water-lagging in the Ferozepore district, but there has been great risk of water-lagging in the Ludhiana district. During the last three or four years the spring levels of wells throughout the area irrigated by the Sirhind Canal have been steadily rising. In the Ferozepore district where the depth to water is great, this rise has been in all cases advantageous. In parts of the Ludhiana district the spring level of wells was already high enough and the further rise has been harmful in two ways,—(1) by its tendency to cause water-lagging, (2) by its damaging wells. An attempt has been made to counteract the former evil by digging certain rajhalas during the winter. This has led to a great outcry among the people, because they say that with their damaged wells they are not able to carry on well irrigation as they could before the canal was introduced. The local inquiries I made certainly seem to show that these allegations are generally correct. The well cylinders in the Ludhiana district consist of brick and

mortar masonry for a few feet, and above this of bricks kept together with clay. The former masonry is generally described as *pakka* and the latter as *kachcha pakka*. In Ludhiana the wells are such by building the well cylinder on the selected site and scraping away the earth from inside. This causes the cylinder to sink gradually, and the sinking is carried on till a stratum of hard clay is reached which serves as a foundation for the well cylinder. Ordinarily the water never rises above the *pakka* part of the well cylinder, but the rise in the spring level due to the introduction of canal irrigation has in many cases caused the water to rise above the cylinder, with the result that the *kachcha pakka* part has fallen in, and the well has become useless. In some cases the damage done is slight, in other cases an entirely new well will have to be constructed. The rise in the level of subsoil water has rendered the sinking of wells in the Ludhiana district much more difficult. The workmen cannot dig down to the permanent water bearing stratum of hard clay, for as soon as they get below the water level the water pours in and stops their work.

The problem in Ludhiana is a difficult one. We have given canal irrigation to people who did not really want it, and by so doing we have caused them in many cases to abandon their old methods of cultivation. We now find that canal irrigation is likely to prove harmful and we are therefore trying to discourage it as much as possible. I think that there is no doubt we are now on the right track but at the same time there can also be no doubt that we are causing a certain amount of hardship in some villages.

C.—Canals of intermittent flow.

12. I believe Rai Bahadur Maya Das will reply to questions 12 to 22, and as I know that both he and I view things from the same standpoint, I do not think it is necessary for me to say anything further.

D.—Tanks.

13. I know nothing about tanks.

E.—Wells.

14. I have not sufficient experience of the working of wells to enable me to pronounce an opinion.

(7) Mr. J. F. FARRANT, Resident Engineer, Patiala.

A.—General.

Mr. J. F.
Farrant.

1. The answers below refer particularly to the tract of country commanded by the Patiala Branches of the Sirhind Canal system. The boundaries of this tract are, roughly, as follows:—On the north the parallel passing through Maler Kotla; on the east and south the North-Western Railway and the Ghaggar river; and on the west the Sirsa-Ferozepore railway line.

My knowledge of this country is based on my experience of five years,—1896 to 1901, during which period I was employed as Resident Engineer to the Patiala Darbar, and had control of their canals.

2. The figures for average rainfall in each month are not available; but the following averages for the three periods "Kharif," "Early Rabi," and "Late Rabi" will probably answer for all practical purposes.

	Inches.
(i) Kharif,—April to September . . .	14·40
(ii) Early Rabi,—October to December . . .	0·71
(iii) Late Rabi,—January to March . . .	2·30
Annual average for tract = . . .	17·53

These figures show that the sowing of the Rabi crop depends upon good rainfall in September or at the end of August.

B.—Canals of continuous flow.

7. (1) The percentage of double-cropped land is about ten; and as the area irrigated annually on the average is about one-fifth of the area commanded, the net increase is about two per cent.

In this tract a gram crop is generally grown on the moisture of the maize crop after it has been cut. To a small extent spinach or vegetables are similarly grown on the moisture of cotton crops. The double-crop area therefore depends on the area of these two crops, which average

40 per cent. of the kharif area. And as stated above the effect of the irrigation is to increase the produce of the area commanded to the extent of about 2 per cent.

(2) The increase in the value of the produce of the land due to the substitution of more or less valuable crops is, approximately:—

Rs. 8 per acre in the Kharif.

Rs. 2 per acre in the Rabi.

The ratio of kharif to rabi area in this tract is very approximately as 1 to 2, and so the average increase in value for the year is Rs. 4 per acre on the area irrigated. The area irrigated being one-fifth of the area commanded, the increase is equivalent to 0·8 rupee per acre of area commanded.

The average value of the produce being taken at Rs. 21 per acre, and assuming that half the area is ordinarily sown annually in rotation, the above increase is equivalent to 7·6 per cent.

The above figures have been arrived at as follows, a year of normal rainfall being taken, and 100 acres of canal irrigated crop compared with the same area of rain-sown crop.

Kharif season.

Canal irrigated crop.	Rs.	Rain-sown crop.	Rs.
6 acres, engarcano @ Rs. 113 =	678	Nil.	
10 " cotton @ Rs. 25 =	250	Nil.	
3 " rice @ Rs. 37 =	111	Nil.	
50 " maize @ Rs. 20 =	600	10 acres @ Rs. 20 =	200
51 " jowar, etc., Rs. 16 =	816	90 " @ " 16 =	1,440
Value of 100 acres =	2,465		1,640
Average per acre =	24·65		16·40

Difference, say, Rs. 8 per acre.

Rabi season.

	Rs.		Rs.
45 acres, wheat @ Rs. 31	=1,895	25 acres @ Rs. 31	=775
55 " mixed crop @ Rs. 20=1,100		75 " @ " 20	=1,500
Value of 100 acres	=2,495		=2,275
Average per acre	=24.95		=22.75

Difference say Rs. 2 per acre.

(3) (a) and (b) not known.

(c) The increase in yield in this case is infinitely large as practically no rain-sown crop has been grown on this tract in years of drought.

8. As no answer can be given to question VII-(3) above, the increase in the yield due to irrigation—it is not possible to answer this question in full. But from the answers to parts (1) and (2) of Question VII it will be seen that the increase due to these two bands is $(1.02 \times 1.476 = 1.098)$ 10 per cent. It will probably be near enough to the truth to assume that the increase in yield is from 10 to 20 per cent. according to soil and facilities for irrigation, i.e., from 2 to 1 per cent. on the whole area commanded. With this assumption the increase in the total annual value of the produce per acre due to irrigation will be—

from $(1.10 \times 1.02 = 1.12)$ 12 per cent.

to $(1.10 \times 1.04 = 1.14)$ 14 per cent.

on the whole area commanded.

The above figures show the benefit of canal irrigation in this tract for normal years.

(2) In years of drought, as practically no crops could be grown, the increase in value is not calculable mathematically by the method above, but can be put in another form. The area sown ordinarily under the canal being 360,000 acres, the area sown in a year of drought would be 410,000 acres. The value of the crops grown would also be higher, and average Rs. 35 per acre. The value of the output then would be $(410,000 \times 35 =)$ Rs. 15,440,000, equivalent to Rs. 8.6 per acre on the commanded area of 1,800,000 acres. Whereas then in a normal year the average value would be increased from Rs. 10.5 * per acre

* $10.5 \times 1.12 = 11.76$

$10.5 \times 1.14 = 12.17$

to Rs. 11.76 or Rs. 12.17 as calculated in (1) above; in a year of drought, when the value per acre would be nil if dependent

on rainfall, canal irrigation gives the land a value of Rs. 8.6 per acre.

Mr. J. F. Farrant.

9. (1) There is no owner's rate. The cultivator pays to the State on an average Rs. 3.55 per acre on the area irrigated during the year.

(2) In Bisivadari villages the cultivator pays the water-rate as above, and gives one-third to one-half of the produce to the Biswadar.

(3) No water advantage or any such rate has been levied by the State so far. Some enhancement will probably be made during the settlement now being undertaken.

10. Practically no expenditure is necessary in bringing the water to the field. The water is delivered inside the village boundary, and each cultivator digs the portion of the water-course that runs along his boundary. In exceptional cases individuals have to bear the cost of digging watercourses to outlying fields.

Manuring is only done to the extent of about 20 per cent. of the area annually irrigated, viz. :—

40 acres per 100 in Kharif } ratio 1 to 2
18 " " 200 in Rabi }

58 out of 300 during year.

or say 20 per cent. For the remaining 80 per cent. there is only the cost of the preliminary ploughings and the division into *Kiaris*.

A liberal estimate of the expenditure would be—

Manured field, Rs. 2.0 per acre.

Unmanured fields, Rs. 0.75 per acre.

or an average of Rs. 1.0 per acre on the area annually irrigated.

This expenditure is usually incurred by the tenant; and without any security as regards recoupment.

11. No damage has resulted to the people; nor has any deterioration of the soil occurred from irrigation without manure. As far as can be seen the soil has been improved by the silt in the water; and as only about one-fifth of the commanded area is irrigated annually there is no sign of water-logging. In fact the irrigation could be extended with advantage in the lower and drier portion of the tract.

(8) LIEUTENANT-COLONEL J. A. L. MONTGOMERY, Commissioner and Superintendent, Rawalpindi Division.

A.—General.

1. Generally to the Hoshiarpur and Sialkot districts, in each of which I served for six years, in the former as Settlement Officer, in the latter as Deputy Commissioner.

2. The average rain-fall in Hoshiarpur is—

	Inches.
April	0.8
May	1.0
June	3.1
July	10.6
August	10.1
September	4.5

Total 6 months 30.1

October	0.5
November . . . . .	...
December	1.0
January	1.6
February	1.0
March	1.6

Total 6 months 6.6

Total for year 36.7

That of Sialkot is—

June to September	21.3
October to December	1.28
January to May	8.96

Total 34.54

Both are submontane districts with a good average rainfall.

3. Both districts.

- (1) No.
- (2) No.
- (3) No.
- (4) No.

(5) Yes, wells cannot be made in some parts, owing to the water springs being too low, or deficient in quantity, and the ground being too uneven to be utilized for irrigation.

In Ilko manner it is impossible to get a continuous supply of water for new canals.

(6) Small irrigation works can be carried out by the people, especially if judiciously helped with advances from Government.

(7) No.

(8) No.

4. Land irrigated by new wells is exempted from enhancement of assessment on account of irrigation for 20 years; the period for old wells which have fallen out of use, and have been repaired, is 10 years. The exemption is secured by the grant of a "patta", which states the term of exemption from assessment at irrigated rates. The same rule would apply to occupancy tenants who had constructed wells at their own cost. I do not think greater liberality is needed; for I have never heard that anyone refrained from making a new well for fear of the revenue being enhanced in 20 years' time. I remember that at Sialkot, where I took some trouble to popularise *takavi* advances, a great many new wells were made while the settlement was actually going on.

The term of exemption for the making of a distributary from a canal is five years.

5. Loans are not taken freely under the Land Improvement Act unless the Collector devotes special attention to

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the subject, and insists on the tahsil officials dealing with all cases promptly and without giving unnecessary trouble to the people. If care is not taken the applicant for a loan has to give fees to various subordinate officials and finds it less troublesome and probably cheaper to borrow from the money-lender even at a higher rate of interest. Again when a loan has been given there is not always sufficient elasticity in the demand for repayment of instalments. If the people could be sure of getting loans promptly and without seeing officials, and if not being too hard pressed for repayment of instalments when in difficulties, I am sure the applications for loans would be much more numerous.

I would answer the subsidiary questions under this head thus:—

(1) No.

(2) No.

(3) No.

(4) Partial remission in every case, total in some cases.

(5) Yes, when difficult times come.

(6) Grants-in-aid are necessary sometimes when it is found that the advance has been under-estimated for the work to be done.

6. The extension of irrigation by large canals undoubtedly has this effect. We have had cases in point lately since the opening of the Chenab Canal. The riverain villages of Montgomery and Jhang were deserted by their tenants when the *Sailab* failed; the temptation to go to the canal lands was too strong to be resisted. In the neighbourhood of the Chenab Canal many requests were made to me by residents of unirrigated tracts to have irrigation extended to them.

B.—Canals of continuous flow.

7. The answer to this question must vary according to the conditions of each district. There are no such canals in Hoshiarpur or Sialkot, unless you exclude a little land watered by hill streams. In Jhang where the Chenab Canal has been brought there can be no produce at all without irrigation, and except near the river, wells cannot be worked because the water is too far below the surface.

8 to 11. No answer.

C.—Canals of intermittent flow.

12 to 20. No answer.

21. In the Sheikhpur district there are a number of canals constructed by private persons. These canals are, as a rule, worked well, but not so well as those inundation canals in the same district which are worked by officers of the Irrigation Department. The private canals belong to big landlords who have constructed them primarily for their own lands, and give excess water to neighbours and take water rates from them. It has not been necessary heretofore for the Government to take over the management of these canals, but two of the principal owners have made an offer to give up their canals in consideration of their receiving water free from the new Jhelum Canal. It is quite likely that the vicinity of the perennial Jhelum Canal will depreciate the value of the neighbouring inundation canals.

22. As a rule, I think it best for the Government to undertake the construction of all canals of any importance.

D.—Tanks.

23. Sialkot District—

(1) The tanks or reservoirs are supplied with water when there is heavy rain in the Jammu hills. They are natural depressions which have been dammed to hold water, some in large quantities supplying several villages, some in small quantities for individual villages.

(2) When in charge of the district I paid a good deal of attention to these tanks. Masonry outlets with sluice gates were provided for all, and the plan of distribution after being agreed to by the irrigators, was recorded in the settlement records.

(3) As a rule these tanks hold water only in the rainy season—

(a) in a year of ample rainfall from June or July to September;

(b) in a year of scanty rainfall in July and August;

(c) in a year of drought they are quite dry.

(4) The area irrigated varies according to the size of the tank. The largest one, the *Satrah Chhamb*, when full, covers about 6 square miles of ground and supplies water to probably 10 or 12 villages. I cannot give exact statistics.

24. (1) As a rule the tanks are utilised only for rice cultivation, sometimes also for sugarcane, maize and cotton. If there is water till late in September it is possible to sow some wheat after irrigation; but as a general rule the water is used only for the *kharif* crops.

(2) Generally only rice is grown on the tank irrigation. Without such irrigation the area under rice would not be more than one quarter or one-eighth.

(3) See answer to 23 (3).

25. (1) If the water comes into the tanks late the area put under rice is diminished.

(2) If the supply ceases early a great deal of the rice fails, for it is most important that this crop should get water when it is ripening. I have known several instances of promising rice crops almost completely failing from want of water at the end; and I always counselled the people not to be too extravagant with their water in the beginning, but to try and save up some of the store for the end.

26. As a rule where there are tanks there are not wells also; but in some places the wells are assisted by tank water. The combination of course makes the cultivation more secure.

27. So far as rice is concerned (and this is the principal crop grown on tank irrigation) it is a case of no produce at all if there is no irrigation.

28. I cannot give exact details. But the usual rent is in kind—half produce—which covers water rates. Of course the greater the produce the more the landlord gets; and this rent naturally depends on the irrigated area. The Government takes a consolidated rate of Rs. 1-12-0 per acre on the average irrigated area of Settlement. If the rate had been a fluctuating one, dependent on irrigation, it would naturally have been much higher.

29. The expenditure required to bring the water to the fields is nominal. All irrigators help to dig and clear the channels, and each man takes the water from such channels to his own fields. The land is worked mostly by small peasant proprietors.

30. The following is an extract from the Sialkot District Gazetteer:—

"The general control of all these irrigation works is in the hands of the district authorities, and during the recent Settlement rules were drawn up providing in detail for each work, and were entered in the records of right of the villages concerned. The whole system is now in order, it works well, and with a little attention on the part of the district authorities there will be no fear of its failure in the future. It has resulted in a distinct addition to the assets of the *samindars* in an appreciable proportion of the villages in the district, and consequently in an increase in the amount of revenue paid to Government. Not only has cultivation largely increased in the tracts affected by these works, but the character of the old cultivation has been raised, while the expense and labour of agricultural operations has declined.

There are altogether nearly one hundred *chhamb*s (tanks) in the district situated chiefly in the flat country on the south-west border, and they serve to irrigate 61 square miles of crops."

The above shows that the system works well. No legislation is needed.

31. Already answered above. The tanks are all the property of the people, and are worked with the aid of the officers of the district.

32. I think every help should be given for the construction of further tanks in suitable places. The people can

make them themselves if they will only combine. It is just combination that is difficult. I found they were only too willing to have the work done and they did it under orders. I used to go over the ground with the people, and then give an order to the Tahsildar to see that the people were collected and set to work. A great deal of the earth-work was done in this way. Sometimes for heavy earth-work and always for masonry outlets, etc., payments had to be made to skilled labourers.

33. The Sialkot tanks are certainly liable to some silting, but the people manage to keep them fairly clear of silt by manual labour.

E.—Wells.

34. There are over 20,000 masonry wells in the Sialkot district. The depth of water varies from 10 to 80 feet, and the area irrigated by each well depends both on the depth to the water level and also on the kind of spring. Some wells are soon worked dry; others have good springs which are practically inexhaustible. The wells cost according to depth from Rs. 150 to Rs. 500 and are all worked with the Persian wheel. In the Hoshiarpur district the wells are fewer, and in many parts they have poor springs and irrigate little land. In the north of the Gurdaspur taluk there are some fine wells with good springs worked by the rope and bucket.

35. (1) In the neighbourhood of towns with plenty of manure and sometimes three crops a year are grown with the help of well water; in other parts also well irrigation allows of the growing of double crops on a portion of the irrigable area where otherwise only one crop or less would be brought to maturity.

(2) It also renders possible the cultivation of sugarcane and other valuable crops, which cannot be grown ordinarily in the unirrigated land.

(3) The yield is increased—

- (a) not in a year of ample rainfall,
- (b) but certainly in one of scanty rainfall,
- (c) while it enables some crop to come to maturity in a year of drought when nothing at all can be produced on unirrigated land.

36. I cannot give this estimate.

37. As before said for tank irrigation the cultivator generally pays his rent in kind, which on well land is never less than half produce; on rich well lands in the vicinity of towns the rent is more commonly a high cash rent, which is at least twice as much as the owner pays to Government. The rates are paid on the total area attached to and commanded by the well; of course in the case of kind rent only that land pays a rent which produces a crop.

38. No. You sometimes hear of a well having been made in a wrong spot; but as a rule the place chosen is the best, and there is no difficulty in the construction except when a stratum of fine sand is reached. I have known of no cases of assistance by Government or by local bodies towards the construction of wells.

39. I believe the construction of Government wells on private property would be unpopular. The people would think Government intruded to establish a right to the land and eventually to eject the owner. It is much better for the Government to give advances and let the owner make his own well.

40. Temporary wells are not uncommon in the Hoshiarpur district. As a rule they are only made where the water is near the surface, and they irrigate only small areas. The water is lifted by the lever and pole with an earthen pot. This kind of well is often found in market gardens.

Where such wells can be dug the people are ready enough to make them in times of drought without special encouragement from Government.

(9) MR. T. GORDON WALKER, Commissioner and Superintendent, Delhi Division.

1.

Irrigation.—1. I have quite recently taken over charge of the Delhi Division and have only a limited knowledge of its actual condition as regards existing systems of irrigation and the possibilities of extending them. On receipt of Government of India Resolution No. 13—61—16, dated 13th September 1901, I issued instructions to all the District Officers in the Division (except Simla) to prepare Memoranda on the subject in such a form that they could be tendered as evidence before the Commission. The results have, I understand, been printed and are in the hands of the Commission.

Programmes of Famine Relief Works.—2. As regards preparation of Programmes of famine relief works there is only one point that I would desire to bring prominently to the notice of the Commission—it appears to me to be one of considerable importance.

3. The lines on which we have been drawing up these Programmes are that for each district liable to famine (the districts or portions of districts are enumerated in the Punjab Famine Code) there should be a list of works that can be utilized as rest and relief works in time of famine, all the necessary details being worked out beforehand, so that whenever the necessity arises any one of the works may be started. It happened that in each district it is possible to find works which would provide a sufficient amount of labour for those likely to come on them. But it will be at once obvious that, while in some of the districts concerned, there is no difficulty in finding a sufficiency of such works, and even of works that are likely to be remunerative, in others it is almost impossible to do so. This may be due to differences in the natural features of the various districts or to similar causes, while, as some of the districts on the Famine Programme list are more liable to famine than others, the available works to them are liable to be more quickly exhausted.

4. In Bahawalpur and Hissar we are now almost certain to have, owing to the failure of the past monsoon rains, severe scarcity or famine. This will follow closely on severe famines in 1896-97 and 1899-1900. The difficulty of providing the necessary amount of labour for the large numbers who had to be relieved in Hissar in the famine of 1899-1900 led those responsible for the operations to look for large work outside the district to which the workers could be transferred. What happened is described in paragraphs 30 and 31 of the Provincial Famine Report (Punjab

Government Resolution No. 203, dated 24th April 1901). The experiment of drafting relief labour to the Jhelum canal failed in a most outward fashion, and no other attempt was made in this direction.

5. I would also refer here to paragraph 29 of the same report as showing the limited extent to which another class of Imperial undertakings, viz., Railways—were utilized as famine relief works. It will be seen that portions of certain lines were used for the purpose of famine relief, but almost entirely for the use of the districts in which the works were situated.

6. I believe I am justified in saying that one conclusion at which the responsible officers arrived as the result of experience in the last Bahawalpur and Hissar famines was as to the practical impossibility of providing on future occasions a sufficiency of work in the district, and the necessity of drafting relief workers elsewhere. Since then, however, we have had the report of the Famine Commission, 1901, which (see paragraphs 55-60) was inclined to favour village works. In paragraph 65 of their Report the question of drafting relief labour to other parts is considered, and the case of the Hissar labourers sent to the Jhelum canal is noticed. The conclusion stated in the final sentence of this paragraph is that "in ordinary circumstances, the risks involved in moving large bodies of men great distances away from their homes do not justify the attempt to draft them."

7. My own view is that District Programmes of relief works should be supplemented by Provincial Programmes of large (Imperial) works, such as Railways and Canals, which should be kept in the same state of preparedness as is insisted on in the case of District Programmes. It is very difficult for a District Officer to find out about these works so as to include them in his Programme, and the duty of having ready at home of such works should be undertaken by the Local Government, at present it is no one's duty. In the instance referred to above—that of drafting from the Hissar to the Shikhar district—the distance was probably too great, but I think a good deal more could be done if the Imperial Government were systematically to draw out and keep up to date a Programme of Imperial works which could be made available for famine relief, and to which relief workers could be drafted from districts within easy reach. The Programme might be made out by Civil (Commissioners') Divisions or by Public Works Department

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Divisions; District Officers being kept informed of what works were available for the purpose of making up deficiencies in their Programmes. From my own experience (limited no doubt) I am inclined to say that sufficient attention is not paid to this portion of the scheme of famine organization, and that there ought to be prepared in addition to the District Programmes other Programmes of (Imperial) works which would be available as famine relief works for groups of districts.

II

1. In paragraph 2 of Financial Commissioner's letter No. 7518, dated 13th December 1901, I am asked to reply in respect of the—

- (i) Ludhiana district.
- (ii) Delhi division.

As regards (i) *Ludhiana*, I was Settlement Officer of that district during the period 1878–83. Just as I completed the settlement the Sirhind Canal was opened, and a very large area of the district has come under irrigation from it. But I have seen nothing of the district since 1883, and am not, therefore, in a position to speak of the present conditions of irrigation in it.

Then as regards (ii) the *Delhi division*, that includes seven districts, with almost every variety of climate and condition which it is possible to find in India, and it would be impossible to answer the questions propounded for the division on a whole. I will, therefore, content myself with some remarks on one or two of the questions which are of general application.

Q. 4. *Protection from enhancement of assessment of land irrigated from works constructed by private capital, etc.*

I am inclined to suggest that the period of protection in the case of new masonry wells should be extended from 20 to 30 years. One ground on which I would support this proposal is the effect this extension would have in getting rid of the misapprehensions which are current on the subject and which undoubtedly at times interfere with the development of well irrigation. Our arrangements in respect of the granting of protective leases during settlement operations provide for an inquiry by the Settlement Officer into all cases where a protective lease is claimable even where it has not been claimed, e.g., if a new well has been sunk 15 years before the new assessment comes into force, the Settlement Officer would grant a lease, even if it were not claimed, for the remaining five years. In this way it is insured that all new (or restored) wells are protected. But the people do not know this, and I have recently come to learn that in the Gurgaon District, where settlement operations will commence before long, and where the necessity for sinking wells is being forced on the people by several years of drought in succession, there is a tendency to hang back because of the fear that the land irrigated

will be assessed at the higher rate. I think that the increase of the period would probably get rid of the apprehension.

Apart from this I think that the period of 20 years is not sufficient. Senior Revenue Officers in the Punjab still remember at least the echoes of the great "Princsep" controversy. It is not necessary to go into the history of that, but I have always thought that one result of the reversal of Mr. Princsep's policy was to induce a tendency to go too much in the opposite direction from that advocated by him, and that the period that was fixed is really too short.

Q. 5. *Takavi for wells.*—The inclination to take advances for the construction of wells varies a good deal with the nature of the seasons. It is by no means a constant quantity. To sink a well costs a good deal of money; and, apart from the uncertainty about striking a good supply of water, there is another consideration which weighs for much with the agriculturist, but is apt to be overlooked by those who advocate more extensive schemes of well sinking. It is not merely a question of constructing a shaft and sinking it. The water has to be raised by a very costly and laborious process. Well irrigation over a certain area requires about four times the amount of human labour that would be sufficient for irrigated cultivation, and very often the labour is not forthcoming. Then the expenses in wear and tear of bullocks, gear, etc., are very considerable.

In the present dry years through which we are passing there has been a decided stimulus to well sinking. But there is no doubt that with a return to years of plentiful rainfall many of the wells that are now being constructed would fall into disuse. There is thus a two-fold danger that people may be tempted to construct wells which either they may not have the power, owing to deficiency of labour or of funds, to work, or which may not really be required, being sunk so to speak in a panic.

As to the terms on which advances are made I think that they might be made more liberal—

- (1) by extending the period of repayment to 30 years, and
- (2) by reducing the rate of interest to 4 per cent.

I do not think, for the reasons given above, that any large schemes of extension of well irrigation are possible. The process must be a gradual one for the simple reason that wells have to be worked. As population increases and holdings are sub-divided the possibility of working new wells increases.

I think that Government is sufficiently liberal in providing funds for distribution by District Officers. For the rest there is no doubt that a great deal will always depend on the amount of attention which the District Officer and his subordinates give to the matter, and on their exertion in inducing the people to take advances, and in making it easy to get them. The other questions of District Administration which need not be dealt with here in detail.

(10) Mr. J. MILLAR, Deputy Commissioner, Ferozepur District.

General.

1. (a) Ferozepur District.

(b) { Nearly two years as Assistant Commissioner.*
" " Deputy " "

2. *Average Rainfall for the past ten years from March 1891 to end of February 1901.*

Month.	Moga.	Tiro.	Sadar.	City.	Muktesar.	Fazilka.	Nabha.	Jalandhar.
January	1.29	1.29	1.33	1.19	.96	.81	.56	1.00
February	1.28	1.37	1.01	1.09	.92	.75	.71	.61
March . . . . .	.49	.40	.49	.40	.49	.30	.38	.17
April . . . . .	.22	.35	.28	.41	.05	.15	.11	.16
May . . . . .	.40	.67	.47	.88	.37	.39	.29	.19
June	2.81	3.12	2.16	2.35	1.44	1.20	.40	2.23
July	5.61	5.41	4.64	4.83	2.93	2.41	4.34	2.14
August	3.68	4.73	4.13	3.43	3.81	2.54	3.76	2.07
September	4.23	3.65	2.89	2.75	2.08	.94	2.17	.73
October . . . . .	.15	.16	.25	.30	.14	.09	.05	...
November . . . .	.01	.01	.02	.01	...	.02	...	...
December . . . .	.43	.29	.40	.41	.22	.15	.36	.06

Mr. J.
Millar.

3.

- | | |
|---------|--------------------|
| (1) No. | (5) No. |
| (2) No. | (6) Not generally. |
| (3) No. | (7) No. |
| (4) No. | (8) No. |

(6) (a) In Moga, in part of Muktesar and in Farilka tahsil the water is too far from the surface for well irrigation.

(b) There will probably be a large decrease in inundation canal irrigation in this district when the dam at Harike Kallan is made. As we are threatened with a large diminution of water-supply there is no inducement to extend canal irrigation below Harike.

4. Protective pattas are given for 20 years; after that time a lump sum is paid yearly according to the conditions of the wells.
* The second part of this answer is not understood.
A. A.

5. Yes, loans are freely taken. I would recommend total remission in cases of failure to obtain water. The interest is very low, the rules are already sufficiently elastic about the period of payment, and the Deputy Commissioner has full power to suspend an instalment when necessary. I would not recommend remission of interest, partial remission of the advance or grants-in-aid.

6. (a) No. It is true that people are clamouring for land on the Chenab and other new canal systems, but this is only a violent form of land hunger.

(b) There is a very strong desire in the Moga tahsil to have a new inundation canal taking from river in Ludhiana District. Whether Government will allow this canal to be made—being above the Harike dam—I do not know. The people, however, have for long time asked for the canal which we propose to call the "Kingwa" the line is at present under survey.

There is no doubt of this intense desire, but there have been technical objections as to plans, etc.
A. A.

12. There are 13 inundation canals in the district, 4 above Harike are fed by the Satlej, 9 below Harike get their water supply from both the Satlej and Beas.

The heads of the canals have often to be changed owing to changes of the river course. There are numerous minors on these canals and their branches; and in the majority of cases there are regular masonry outlets.

I make no remarks on the canals as the subject has been discussed in evidence.
A. A.

Masonry weirs have also been constructed to irrigate lands on a higher level than the canal.

The supply is maintained for five to six months in years of ample rainfall. The minimum period is four months.

13. (1) Rice cultivation has been started on a large scale in this district; gram is sown immediately after the rice crop. Doublecropping is quite usual, e.g., wheat after jowar.

(2) Maize a valuable crop freely sown on canal lands, this crop is practically never grown on rain land.
In Ferozepur.
A. A.

(3) (a) In a good year yield is increased from $1\frac{1}{2}$ to $1\frac{3}{4}$ times that on rain land.

(b) In a year of a scanty rainfall the yield is perhaps 2 to 3 times as much.

(c) There is no barani here in a year of drought.

14. I have never known the inundation canals too late for the kharif sowings of bajra and jowar. Of course people prefer as large an area as possible of rice and maize.

Rice fails when the water-supply ceases very early and maize also is very badly affected.

15. As the inundation canal supply depends entirely on the level of the river, it sometimes happens—especially near the tail—that crops suffer severely. As a general rule except in the Roki Canal irrigation is supplemented by wells. In years of ordinary rainfall this is not necessary, in a bad year wells can only save a certain amount of the canal irrigated crop. Khurda is allowed freely on canals, full rates are not imposed on land watered but not sown.

The canals are under District Staff.
A. A.

16. (1) At the least estimate one and half times to twice as much.

(2) In a year of drought barani crop if sown is practically worthless.

17. (3) About $14\frac{1}{2}$ annas per acre water advantage rate are paid on superior crops, e.g., maize, chillies, etc., half rates on other crops, e.g., bajra, jowar. This is on the canals made by the zemindars themselves. In addition there is the establishment rate and the silt clearance rate, both these items together come to 11 or 12 annas per acre.

(1) On inundation canal owned by the Nawab of Mamdot Rs. 1-8-0 per acre in addition is charged.

(2) Butai is usually paid—the charge from $\frac{1}{2}$ on barani to $\frac{1}{2}$ on canal lands or from $\frac{1}{2}$ to $\frac{1}{2}$ is not uncommon.

(4) Nil.

The water advantage rate is paid on the crop only.

18. All small irrigation channels are made by the tenant. Any expensive work, e.g., a masonry outlet is paid for by the landlord.

19. In Zira I am inclined to think that canals have caused a certain amount of salt efflorescences. In any case the water there is near the surface and on well areas I have noticed even more efflorescence than on canal watered land. It is said a soaking with canal water will often temporarily remove kallar—probably the silt in the water covers it. Zira has usually a fairly heavy rainfall. The people on the whole are extremely lazy. Canal water has certainly made the land harder to work. The result is that owing to pure laziness a good deal of land has been left uncultivated.

20. Establishment, silt clearance, repairs (of not too expensive a character) are paid by the irrigators according to 'bachh.'

There is a regular canal Wajeb-ul-arz and the system has worked very well so far. The great defect is that only an intelligent man properly trained in the particular work can look after the canals thoroughly.

21. The Nawab of Mamdot made several of the inundation canals, but the District Canal Department looks after them. The Nawab could not realize arrears under Section 98(d), Revenue Act.

22. No. The inundation canal system is necessarily wasteful and has had its day. The canals have worked well, but cannot be compared with the Sirhind Canal system, which distributes water scientifically. One might extend an existing canal, but I would not recommend private persons, e.g., Nawab of Mamdot, to construct a new one.

(1) River tract—10 to 16 ft. Adjoining river tract—20 to 40 ft. Uttar and Rohi—anything between 40 and 200 ft.

(2) Percolation water usually sweet.

(3) From Rs. 100 to Rs. 3,000.

(5) Persion wheel or bucket.

(6) 30 acres.

(7) 12 to 15 acres.

35. (1) Most well land is "dofnali."

(2) When a man makes a well he naturally grows valuable crops like cotton, maize, sugarcane okillies, vegetables.

(3) (a) Yield is usually twice as much as on barani land (this has been found out from many crop experiments).

(b) Given a fair number of waterings, the yield is between 2 and 3 times as much.

(c) There is practically no barani in a year of drought.

36. (1) At least 2 to 3 times the value of barani crops.

(2) No comparison.

37. (1) It depends a great deal on the land. Probably Rs. 2 as a minimum, but cash rents are only common in one tahsil.

(2) After the protective patta has expired, lump sums, varying from Rs. 3 to Rs. 18 per well per annum, are paid. The amounts are fixed at settlement.

38. The zemindars with their local knowledge and experience know the likely places for wells much better than we could tell them. They can safely be trusted in the matter.

I quite agree with this.
A. A.

39. No.

40. Yes. Kacheka wells are common in the riverain tracts. They are of considerable assistance in times of drought. They do not cost much, and I am always ready to give takavi for them where necessary.

Mr. J. Millar.

(11) CAPTAIN F. E. BRADSHAW, Deputy Commissioner, Jullundur.

Memorandum by witness.

Captain
F. E.
Bradshaw.

Part A.—General,—namely, questions 2 and 5, and the whole of E.

A.—General.

2. The average rainfall in each month of the year based on figures for three years is as below:—

January	. . . . .	2'69
February	. . . . .	0'98
March	. . . . .	1'11
April	. . . . .	0'45
May	. . . . .	2'18
June	. . . . .	2'29
July	. . . . .	8'70
August	. . . . .	8'60
September	. . . . .	7'94
October	. . . . .	'20
November	. . . . .	...
December	. . . . .	1'28

5. Loans under the Land Improvement Act are not very freely taken in this district. 237,981 acres were irrigated in 1881-82 from wells and the area has steadily increased to 300,568 acres in 1900-01 and the number of wells from 20,029 to 27,454. But see paragraph 14 on page 107 of Mr. Purser's Settlement Report.

A. A. During the two years I have been in charge, the following advances have been made:—

In 1900-01.—No money was available for such advances till the middle of December, after which time the restrictions to advances were removed, and Rs. 4,000, were allotted and advanced.

In 1901-02.—Rs. 12,000 were allotted in April and distributed. In July another Rs. 4,000 were allotted and spent and in November a further grant of Rs. 8,000 was made which will probably suffice for our wants.

E.—Wells.

34. (1) The average depth of wells in each of the main tracts is as follows:—

Nawashahr tahsil	20 feet.
Phillour	" 27 "
Nakodar	" 13 "
Jullundur	" 10 "

(2) In the low-lands the supply is probably chiefly from percolation and in the uplands from springs and percolation combined. The supply is sufficient in ordinary years, but in 1900, for the first time in many years, the water in the wells began to fail. Mr. Purser says there is no record of a total failure of the rains in Jullundur, but if such a calamity should ever happen, the wells will not save the country from ruin.

(3) See pages 101 and 103 of Purser's Settlement Report. The average cost of wells is now said to be—

	Average.
	Rs.
Jullundur tahsil	250
Nakodar	from Rs. 250 in the wet to Rs. 350 in uplands
Phillour Rs. 300 to Rs. 400	350
Nawashahr Rs. 100 in lowlands to Rs. 300 and 500 in uplands, say	250

(4) The average duration of a permanent well in which good materials have been used is said to be not less than 20 or 30 years. But some of the wells constructed in Sikh times are still in use.

(5) See page 103 of Purser's Settlement Report. There are three kinds of wells, namely, the lever wells, the rope and bucket wells and the Persian wheel wells.

The first kind are only found in the low-lands of the Sirwal and Bot Circles and are uncommon.

The rope and bucket wells are common in the Nawashahr, Phillour and Nakodar tahsils. In the Jullundur tahsil the Persian wheel only is used.

(6) This varies in different tracts, from 5 to 21 acres. The rope and bucket wells have a greater irrigating capacity than the others.

(7) The average area irrigated in one year is—

	Acres.
Single wells	8
Double "	15

NOTE.—Single wells are those where one bucket or one Persian wheel is used at a time.

NOTE.—Recently 20,697 wells irrigated 3,147,869 kanals = 116 K. of 11 acres per well.

85. Irrigation may enable the cultivation of two harvests instead of one, but only on land where manure is plentiful.

"The soil of Jullundur and Nakodar is too light for profitable irrigation without heavy manuring, so it is better to cultivate a small area very highly than a larger area roughly; while in Nawashahr and Phillour the soil is firm and strong enough to bear irrigation with light manuring supplemented by fallows, and as the stiff soil requires more moisture than is always afforded naturally by rain, the people find it advantageous to extend irrigation as much as possible even at some sacrifice of quality." (see page 109, Settlement Report).

(2) The value is sometimes trebled when valuable crops, such as sugarcane and cotton, are cultivated. Sugarcane is the revenue-paying crop of the district. The area varies according to the Zemindar's views concerning the sugar market. About seven-eighths of the cane grown is irrigated. The cultivation of this crop in the district is mainly owing to the number of wells in use.

(a) Well irrigation decreases when there is ample rain as the cattle are allowed a rest, well water not being required.

(b and c) In both these cases well irrigation saves crops that would otherwise fail and the value of the surplus produce, if any, available for sale naturally depends on the demand caused by scarcity elsewhere.

36. What is the chief crop on rain land, and in normal years one acre of rain land produces 13 maunds of wheat, while a similar area irrigated from wells produces 21 maunds of wheat. This would at Rs. 2-8 per maund = (21-13) = 8 × 2½ = Rs. 20.

(2) In 1898-99 an acre of rain land produced only 11 maunds while well land produced 26 maunds. The value at the rate then prevailing, viz. Rs. 3 per maund was (26-11) = 15 × 3 = Rs. 45. But, of course, there would not be much surplus available for sale in a famine year.

37. The rent paid by a tenant for rain land varies from Rs. 5 to Rs. 7-8 per acre, while the rent of well lands varies from Rs. 15 to Rs. 25 per acre.

The people distribute the revenue among themselves in the following proportions—

Villages—

In 219—	2 shares on wet, 1 on dry land.
" 139—	3 " " " 2 " " "
" 106—	5 " " " 3 " " "
" 29—	11 " " " 5 " " "
" 17—	0 " " " 7 " " "

(See page 178, Settlement Report.)

38. See paragraph 6 on page 100 and paragraph 14 on page 107, Settlement Report.

No assistance has apparently ever been rendered by Government or by local bodies in the shape of expert advice, etc. Advice is not apparently needed as the people construct wells without it.

39. I am not in favour of the construction by Government of wells in this district in land which is private property.

40. Temporary wells are only used in years of drought, and then rarely, as the district is protected by its permanent wells.

(12) Mr. W. A. Le Rossignol, Deputy Commissioner, Ludhiana.

A.—General.

LUDHIANA DISTRICT.

1. I have been here since April-1898, with the exception of 6 months spent on leave.

2. The average for the past five years is as follows:—

June	1.09
July	6.64
August	6.67
September	3.4
October . . . . .	.11
November . . . . .	.02
December . . . . .	.56
January . . . . .	.97
February	1.53
March . . . . .	.25
April . . . . .	.65
May . . . . .	.26

The annual average is 22 5.

3. (1) No.

(2) No.

(3) No.

(4) Yes, a large portion of the district is too sandy for irrigation.

(5) No.

(6) No.

(7) No.

(8) No.

(9) No.

4. It varies from 20 to 10 years (see Financial Commissioner's order) in this district. Exemptions are as a rule applied for and granted only at settlement. No applications are received until the settlement is on the eve of expiry. The date of the construction of new wells is noted in the Jamabandi and Milon ragha of the note books. Tenants-at-will do not extend irrigation at their own cost, and occupany tenants are sufficiently protected by the statutory law re enhancement of rent.

5. Not very fully, because in the Jungal water is too deep, in the centre of the district there is canal irrigation and the people are well off, in the Dhaya Nioha the soil is too sandy for wells, and in the Bet the natural moisture is plentiful. In years of drought, applications are plentiful, but mainly from poor people who have exhausted their credit with the *bania*.

(1) No.

(2) Yes.

(3) No.

(4) This case is too rare to be worth considering.

(5) No.

(6) No.

6. No, the pressure of population is great all over the district except in the Jungal area.

B.—Canals of continuous flow.

7. (1) The second crop in that case would be half a full crop.

(2) After allowing for extra labour and manuring, the crop value would increase by about 50 per cent.

(3) (a) Not at all.

(b) The outturn is twice as much as it would otherwise have been.

(c) The outturn varies immensely in times of drought, the canal flow is often weak, but an average crop is as a rule produced.

8. (1) $\frac{1}{2}$

(2) ———

9. ———

10. Nothing worth mentioning. Small channels are made by the zemindars themselves. The tenants make their own, and are only too pleased to get the water.

11. Fever has been very virulent and prevalent of late years in the district, and this is not in all probability unconnected with the marked rise in the general water level.

Tanks.

23. There are no irrigation tanks in this district.

Wells.

31. (1) Bet, 10 feet. Dhaia, 45 feet.

(2) Mainly from springs; the supply is as a rule good, but in protracted drought it fails; the water in some of the Bet wells often becomes too saline for use.

(3) In Bet 100, in Dhaia 300 to 650.

(4) An old well, i.e., one constructed with lime made out of "Chunna" burnt with "Dhak" wood (*Butea frondosa*) will last 100 years; a modern jatty built well lasts 60 years.

(5) By "Chazra."

(6) In Bet 7 or 8 acres. Dhaia 13 or 14 acres.

(7) In Bet 7 acres, of which 3 are "dofali," i.e., 10 acres of "ajnas." In Dhaia 13 acres, of which 7 are "dofali," i.e., 20 acres of "ajnas."

35. As in No. 7.

37. (1) Bet 7 and Dhaia 12.

(2) About double.

As a rule, a lump sum is paid for a holding on a lease, but in many cases the full amount stipulated is not exacted if the season has been unfavourable.

38. (1 and 2) No. No. No.

39. No.

40. Yes, in the Bet they are useful only for growing small quantities of valuable garden crops, which enable the people to subsist in a bad year. No encouragement is needed, as they are rapidly and easily made by the people on their own initiative.

NOTE.—This district has suffered by the irrigation from the Sirhind Canal of land that used to be irrigated from wells. The water level is rising, and the subject has been under consideration for some time. Arrangements are completed for restricting rabi irrigation in certain places and encouraging a return to well irrigation. The correspondence on this subject may be consulted.

A. A.

(13) CAPTAIN B. O. ROE, Deputy Commissioner, Kangra District.

A.—General.

1. Kangra district generally including Kuln. I have on two occasions officiated as Deputy Commissioner of Kangra for a few months, and my proper post is Assistant Commissioner in Kulu.

2. Average rainfall at the head-quarters of the district is as follows:—

Inches.	Inches.
January . . . 4.77	July . . . 4.10
February . . . 4.18	August . . . 38.57
March . . . 3.81	September . . . 11.78
April . . . 1.87	October . . . 1.23
May . . . 2.65	November . . . 0.55
June . . . 8.67	December . . . 1.10
26.97	57.83
	26.97
	84.80
TOTAL . . .	81.32

4 Punjab

These figures are really of no value whatever, as the average rainfall in Hamirpur, the driest tehsil, is a little over half these.

I agree.

A. A.

3. (1) to (8) No.

(9) Out of a total of 589,626 acres of cultivated land, 117,020 acres are irrigated by the zemindars' kulis. The remainder does not require irrigating. If it did, the zemindars would make kulis out of the *nallahs* and so irrigate it.

See remarks for Hoshlarpur.

A. A.

5. There are at present the following sums:—

	Rs.
Out in Takari; under Act 19 of 1883 . . .	0,162
Do. do. 32 of 1884 . . .	175
TOTAL . . .	6,337

Mr.
W. A. Le
Rossignol.

Captain
B. O. Roe.

Captain B. C. Roe. I have no real experience of the working of these loans, and can give no opinion on any of the points raised.

6. Not that I know of—

No.

Not that I know of.

(b), (c), (d) There are no canals of any description in this district. The irrigation is done by water channels from the mountain torrents; these can hardly be classed as canals.

(e) The irrigation from wells is so slight in this district as to be practically nil.

In ennesion, I would remark that practically the whole irrigation in this district is done by channels from the streams and torrents, and the best way we can assist in helping the people is by giving them help sometimes to repair these channels, when they go wrong. In Kohn I often give grants from the Kothi funds to improve these water channels. The zemindars understand the working of them and are often very ingenious in their construction. The less we interfere the better.

I agree.

A. A. Every drop of water almost is somebody's right and any attempt to extend the system of irrigation would, I think, only result in friction, as somebody's rights would be interfered with or somebody would think their rights were.

(14) *Major H. S. P. Davies*, Deputy Commissioner, Simla District.

Major H. S. P. Davies.

Q. 1.—A. 1.—The Delhi District. As Deputy Commissioner from November 1894 to March 1899.

3.—A. 3.—(1) No. (2) No. (3) No. (4) No. (5) No. (6) No. (7) No. (8) No. (9) There are no reasons that I know of except those of a physical nature.

4.—A. 4.—My only experience extends to wells. Enhancement of assessment on account of irrigation from new wells is not made during the term of settlement. At a new settlement land which was not irrigated at the previous settlement, but which has since become irrigated by the sinking of a new well, is granted a protective lease for twenty years from the date when the well commenced to be worked. The owner does not always reap an advantage, it depends to a large extent as to how the villagers distribute the revenue over the land. The Settlement Officer assesses each village on his own estimate of the producing value of each class of land, but the internal distribution, if left to the villagers, is often not in accordance with these estimates. It is by no means uncommon to find a single rate for distribution used for both irrigated and unirrigated land. Occupancy tenants enjoy practically the same exception, as the landlord and tenants-at-will are, I consider, sufficiently protected by the provisions of Chapter VI of the Punjab Tenancy Act.

5.—A. 5.—Loans under the Land Improvement for the extension of irrigation are not freely taken. Probably the chief reason is that people with any credit prefer on most occasions to go to their own banker, rather than to Government. In the latter case there has to be an enquiry, the Collector may not have money at his disposal, the loan sanctioned may be less than that asked for, and the fear of what may happen if the instalments are not punctually paid induces the borrower to try elsewhere first. The ordinary cultivator dislikes being brought in contact with officials, and this fact will always weigh against the popularity of such loans. It is the impecunious and the man without credit who comes to Government for a loan in an old settled district like Delhi, and even if he gets it, the result is seldom any benefit to the permanent irrigation of the district. I do not recommend any of the proposals (1)–(6).

6.—A. 6.—I do not consider so, though in case of a new canal being opened cultivators are attracted and there is temporarily a difficulty in keeping tenants, but the cause is never, I think, a lasting one, and after one or two harvests normal conditions again prevail. When the Ghannab Canal was first opened, many of the tenants from the river villages in Gajrat district, which had been suffering from bad years, left, and there was difficulty in retaining tenants, but waters soon righted themselves. I cannot say there is any strong desire on the part of the people of the district to have means of irrigation increased, though those who do not get canal water by flow would probably like to have it.

7.—A. 7.—(1) The answer to this depends almost entirely on the rainfall of the tract. The average annual rainfall of Delhi is shown as 28 inches, it probably decreases to nearly 20 inches in the southern portion of the district. I am of opinion that where the average rainfall is 28 inches or over, the value of the produce of the land on account of irrigation rendering it possible to cultivate two barres instead of one is increased but very slightly.

(2) Irrigation leads certainly to the substitution of more valuable for less valuable crops. I think that such increase can be estimated at not less than 20 per cent., but I am unable to verify this by figures.

(3) (a) In a year of ample rainfall, I do not consider that the increase of yield through irrigation and its conse-

quent increase in value is appreciable. The crops on rain lands are usually under these circumstances quite as good, sometimes even better, than those on irrigated lands.

(b) In a year of scanty rainfall the produce of an acre of irrigated land, I think, be taken as 100 per cent. greater than that of an acre not irrigated.

(c) This question is almost impossible to answer. Real drought means no crop at all on unirrigated land and a crop on irrigated land which depends on the amount of water it has been possible to give the land. The increased value of such crop depends on the market rate, which is not necessarily high on account of a local failure.

8.—A. 8.—(1) An approximate estimate can be obtained by taking wheat as a standard in an average assessment circle and ascertaining the difference in value of an irrigated and unirrigated crop found to exist by the Settlement Officer. The value of an acre of wheat was found to be on irrigated land Rs. 17-6-6 and on unirrigated land Rs. 8-2-4. Increasing the value of the irrigated crop by 20 per cent. for the reason given in my answer to question 7, I obtain Rs. 19-7-11 as the value per acre for an irrigated crop as compared with Rs. 8-2-4 for an unirrigated crop. The approximate increase in the value of the crop due to irrigation in normal years is 123 per cent.

9.—A. 9.—The rate varies according to the nature of the crop from Rs. 5-10-0 for sugarcane to Rs. 1-12-0 for khorif crops per acre. The actual rates are given in Punjab Government Notification No. 431, dated 19th February 1895. The average rate per acre is probably a little over Rs. 3.

(2) The average rent for canal lands is per acre Rs. 7-6-0 and for other unirrigated lands Rs. 4-4-0. The difference between these Rs. 3-2-0 is the increase obtained by the owner from the cultivator in the form of enhanced rent on account of irrigation.

(3) In this district an owner's rate is levied, which is assessed at half the occupier's rate. Using the figures given above, the average owner's rate per acre is something over Rs. 1-5-0.

In each of the above cases the rate is paid on the area actually irrigated, owner's and occupier's on area irrigated each harvest, and rent on the canal area held during the year.

10.—A. 10.—The private expenditure necessary to bring water to the field is usually very small, as the majority of the cultivators are owners; the expenditure is generally incurred by the owners; if such is undertaken by the tenant, he is, I consider, amply protected by the provisions of the Tenancy Act.

11.—A. 11.—The two northern tabsils of the district receive irrigation from the Western Jumna Canal. The following extracts from the report of the Settlement Officer, written at the end of 1890, will give an idea of the effects of this irrigation in the district:—

"It appears that the Delhi Canal is a work of considerable antiquity, certainly some centuries old, and the tradition of the countryside says that after copious and long continued irrigation the Bangar chack of the district became ruined with reit, that the canal was given up, and people took to wells, or to dependence on the rainfall, to nourish their crops. I do not know how far this is true, but about the year 1815 A.D. the canal water was re-introduced."

Major
H. S. P.
Davies.

It appears that clearance, the result of which it was hoped would be to bring under cultivation vast tracts now deserted, was commenced in 1816, and that the canal was running in 1819.

"At the regular settlement in 1842 little damage from water-logging seems to have been noticed or even apprehended. But in 1856, remissions from silt began, and others were made in 1858, and since then the subject has been one of constant anxiety to all officers acquainted with the state of the case. Moderate irrigation and good drainage are all that are wanted to restore the Bangar of Delhi to the beautiful fertility described by John Lawrence about forty years ago, as allowing one to ride for miles as through a highly cultivated garden."

In his detailed remarks of the Bangar villages of the Delhi tahsil, the Settlement Officer writes: "The mainstay of irrigation is the canal: great damage has been experienced in not a few of the finest villages from a recklessly copious use of canal water, aggravated by a bad system of drainage, which of itself is an enormous evil. The proprietors of this chack are almost entirely Jats, good cultivators by nature, but seriously debilitated in body, and not a little demoralized in mind by the misuse of the canal."

Ahead the Sanipat villages he writes: "Beyond this we come to the valley of the canal which traverses the whole length of the tahsil. Here is copious and long continued irrigation, and the soil almost everywhere shows marks of exhaustion. Yet it is plain that the canal water, before by abuse it turned into a curse, was for a considerable time a blessing. The fiscal history of the villages shows that for long after the re-introduction of the canal, the quality of the soil continued to improve by reason of the valuable silt deposited by canal water on it. It was only when the process of water-logging began that this benefit was first minimized, then neutralized by the destructive silt rising up to the surface. Since then the evil has predominated more and more, till at present the cultivable area in some villages only a fractional proportion of what it was."

The original alignment of the canal was, I believe, bad. It did not follow the higher contours of the country, but in places crossed the natural drainage lines of the land without allowing sufficient outlet for the water. This had the effect of not only causing swamping by holding up the drainage, but also of water-logging by percolation from the canal. The canal carried more water than was necessary for the purposes of irrigation and water was therefore always available. The assessment was fixed and did not depend on the area irrigated, so there was every inducement to over-irrigation and waste of water by the cultivators. At settlement in 1880, the system of assessment was changed, land was assessed in its dry aspect and all water taken from the canal was charged for according to the crop and the area. Much of the canal has since been re-aligned, provision has been made for passing the natural drainage, the amount of water available has been considerably reduced by making new branches, and several main drains have been cut under the supervision of the Canal Department.

The result of these changes has been that reil or shor does not appear to be on the increase in the canal irrigated tract, and as far as I can judge, its condition is now much improved from what it was when the Settlement Officer wrote, although some villages still remain in their former state, the result of insufficient drainage. Probably a combination of the changes introduced have brought about the result. My experience does not show that drainage is necessary for irrigated land if the irrigation is under proper control and not excessive, but drainage is required if the natural drainage has been interrupted or reduced by irrigation works.

31. A. 31.—The Delhi district is about 60 miles long from north to south, and has an average breadth of 20 miles. The river Jumna forms its eastern boundary. It may be roughly divided into two main portions—the low Khadir lands lying near the river, and the higher Bangar lands. A line of hills starting from the edge of the river in the middle of the district runs across the district in a south-westerly direction. On the west of these hills are the low-lying lands known as the Najafgarh Jhil. As compared to the Bangar proper, proximity to the hills increases the depth to water level, while nearness to the Jhil decreases it.

(1) The average depth to water in the Khadir is 15 to 20 feet, and in the Bangar about 30 feet.

(2) In the Khadir the supply of water is from percolation from the river, in the Bangar it is from springs and from percolation from the canal. In the uplands in ordinary years the wells cannot be constantly used, the water gives out,

and they have to be rested for three or four hours before being again worked. In years of drought the permanent water level falls several feet, and the supply of water diminishes, but it is very unusual for a well to run altogether dry. In the Khadir wells the supply of water is fairly constant. I am not aware of any cases in which wells have become too saline to be used for irrigation.

(3) The average cost of construction of wells is Rs. 300 to Rs. 500 in the Bangar and Rs. 300 or less in the Khadir.

(4) My estimate of the average duration of a modern well is 60 years.

(5) North of the town of Sunipat water is raised by the Persian wheel, in the rest of the district it is raised by the rope and bucket.

(6) and (7). At settlement the average area irrigated per well works out at 108 acres in the Khadir, and at 76 acres in the Bangar. I understand that this represents the actual area that was found under irrigation at the time of measurements. I am unable to give present figures, as I am not in possession of the statistics.

37. A. 37. (1) This is a difficult question to answer; if I had access to the district records, it might be possible to quote statistics, but probably they would be misleading. In the large majority of cases the rent of land is either a fixed share of the produce, or the land revenue assessed with some added percentage. The share of produce taken by the owner is generally one-third or two-fifths, this is taken on the whole holding whether the crop is irrigated or not. The increase in rent due to irrigation would be the increase in the value of the produce which falls to the share of the landlord. Its money value per acre irrigated is indeterminable.

(2) At settlement the rate put on irrigated land was Rs. 1-6-0 to Rs. 1-10-0 more per acre than that put on unirrigated. Land considered irrigated was the land found to have been actually watered during the year of measurement. This must be presumed to be the average enhancement per acre on account of irrigation. This presumption was not recognized by the people in distributing the revenue within the villages, as out of a total of 810 villages, in only 126 was any distinction made between irrigated and unirrigated land in the distribution of the revenue among the individual holdings. In the large majority of cases the distribution was made by a single all round rate.

39. A. 39. Serious difficulties in the selection of a spot are very seldom encountered, water is practically always obtainable, the doubt is about its quantity and quality. The chief difficulty in the construction of a well occurs when the cylinder reaches unstable sand, it is hard to prevent the sand running in, and the permanency of the well is affected by it. No expert advice has to my knowledge been ever offered, and it is very doubtful whether the ordinary cultivator would accept such advice, especially if it was at all contrary to the custom and practice of the country.

39. A. 39. I am not in favour of the construction by Government of wells in land which is private property. The expense would be far greater than if done by the owner. It would certainly cause some amount of distrust among the people, and it would be with difficulty that land for the purpose could be obtained. In this district, where Government owns a number of villages and has so far, as landlord, never carried out any works of improvement, it would appear extraordinary to begin to improve the land belonging to others.

40. Temporary wells are used in the Delhi district to some extent, especially in the Khadir and round the Najafgarh Jhil where the water is near the surface. They are a protection against famine, inasmuch as they enable the producing of a crop sufficient for the absolute necessities of the owner. In a year of scanty rainfall I would encourage the construction of such wells by a liberal grant of takavi, the money should be distributed after local enquiry on the spot, and easy terms of repayment should be sanctioned.

37. A. 37—(continued.) (1) The following figures have just been received from the district officers, so I include them as showing the recorded values. The average rent per acre for chahi or well-irrigated land is Rs. 7-14-0 and for barani or rain land Rs. 4-4-0; the difference of Rs. 3-10-0 per acre represents the enhancement of rent due to irrigation paid by the cultivator. The cultivator pays rent on the area of his holding capable of being irrigated, although it may be impossible to irrigate the whole area in any one year.

(15) W. M. HAILLEY, Colonization Officer, Jhelum Canal.

*A.—General.**Mr. W. M. Hailley.*

1. My answers refer entirely to the Thal tract of the Dera Ismail Khan district. I was Assistant Settlement Officer at Bhakkar from November 1899 to October 1901, and lived in the Thal tract the whole of the time.

2. The figures of rainfall are as follows:—

Five years 1885—1890	. . .	4.56 inches.
Five years 1890—1900	. . .	6.76 "

These figures have been taken from the registers at Bhakkar, Lelab, and Nurpur at the edge of the tract. The rainfall in the tract itself is less than the average here shown.

3. The rainfall is so small that there is practically no barani cultivation, and what there is gives a very precarious return. The only irrigation carried on at present is by means of wells. The chahi area of the Thal Kalan Circle is only 7 per cent. of the total area of the Circle; that of the Daggar Circle is only 3.8 per cent.; and that of the Jandi Thal Circle is only 8 per cent. Though the population is very sparse, this does not in itself constitute an obstacle to the extension of irrigation. The chief obstacles are:—The cost of the cattle necessary to work the wells (the depth of which is from 60 feet in the north to 17 feet in the south); the pooriness of the soil, which necessitates the use of a great deal of manure; the insufficiency of the fodder supply; the heavy expenditure on well wood-work (the country being treeless) and on well ropes. Extension of well irrigation is not, I think, hampered by the fear of increased assessment. I have never had this cause pleaded to me. Nor is there any fear on account of the unknown of rent. The tenant is completely master of the situation, and can get any amount of land at a purely nominal rent. I know of no defects in the tenancy law in this respect. The obstacles under the present circumstances to the extension of well irrigation are purely natural. At the same time, I may note that for some years past Government has discouraged the construction of wells in the waste lands of the Thal villages, as it was supposed that the existence of a large number of scattered wells would embarrass us in colonizing the waste in the event of the Indus Canal being constructed. I doubt if this has seriously interfered with the extension of the chahi area, as it has always been difficult to find tenants for existing wells, and it would at any time have been possible for persons wishing to cultivate to have found any number of wells at nominal rates of rent. I do not, however, think the policy at all a good one, and would suggest that it be carried out in the future with less rigour.

4. New wells are in most of the villages exempted from revenue for the first three years, and pay half rates for the next seventeen. In some of the villages the period of half exemption is ten years only. The exemption is secured in practice by the grant of protective leases. The original arrangement was that the revenue on all new wells should go to the village, and not to Government, and the village could respect the protective lease or not as it liked. As a matter of fact, it generally did respect it. Under more recent arrangements revenue of this kind goes to Government, and the protective leases are of course respected. As regards tenants, I don't think that there is any case of a tenant extending well irrigation to his land at his own cost; wells are always built by the owners. The cost is far beyond the means of any tenant.

I would extend the present provisions—as has lately been done in the case of Multan—by giving a clear exemption from revenue of any kind for twenty years. This would be ahead of the practice in the neighbouring districts, but considering the cost of new wells and the backwardness of the tract, I don't think that the liberality would be excessive.

5. So few wells have been built within the last ten years that it is difficult to answer this question. Speaking on general grounds, and not in connection with this tract especially, I am in favour of reserving takavi loans for the construction of wells when the well proves to be structurally a failure. We may be quite sure that the natural antipathy of the landlords to recommending a remission of any sort would prevent this concession from being overworked. The procedure with regard to takavi advances has been much simplified of late years, and immensely for the better, but a great deal more remains to be done by (i) distribution by the Revenue Assistant on the spot, (ii) suspension of instalments in bad times, (iii) working up to the full period of 20 years in fixing instalments, and fixing them in such a way that the instalment of takavi should be recovered merely as an addition to the land revenue. Takavi instalments are not always collected, as they should be, at the same time as the land revenue. I think that the State should be willing to take interest and repayment of the takavi in the form of increased land revenue.

6. Wherever irrigation is extended largely and quickly, it naturally injures the remaining cultivation. This has grown to be a commonplace on the lands near the Cbeoab Canal, the effect of which has also been to make it more difficult to get tenants in the Thal. But there is a very general desire among the agriculturists of this tract to have canal irrigation introduced from the Indus. The desire is of course less keen on the part of the graziers.

B. C. D. There are no canals or tanks here.

E.—Wells.

34. The average depth of wells in the Thal Kalan Circle varies from 60 feet in the north to 31 in the south. In the Daggar Circle it varies from 42 in the north to 31 in the south, and in the Jandi Thal Circle it varies from 26 in the north to 17 in the south.

(2) The supply is from percolation, and I have heard of very few cases indeed of it running short, though the wells are as a rule worked both day and night. In a year of bad drought it is sometimes necessary to work them in the daytime only. They are as a rule cleaned out once a year, as the sand flows into the well cylinder with the water. There is a good deal of scouring under the masonry at the bottom of the well, and repairs are as a general rule necessary once a year on this account. In only a few villages at the south of the tract does the water become saline in summer. In these villages the water is full of salt all the year round, but in summer it becomes quite unfit for drinking, and the wells are usually closed.

(3) The cost of construction is from Rs. 550 in the Thal Kalan to Rs. 350 in the Jandi Thal.

(4) I cannot give anything like exact figures of average duration. There are wells which have been working more or less continuously for 160 years. I think that the duration of a well is determined more by the quality of the soil and the circumstances of the owner than by the failure of water-supply.

(5) The water is always raised by a Persian wheel.

(6) The average commanded area attached to a well in the Thal Kalan Circle is 19 acres; in the Daggar 21½ acres; and in the Jandi Thal is 20 acres.

(7) The average area irrigated yearly in the Thal Kalan Circle by each well is 18 acres; in the Daggar 19 acres; and in the Jandi 18 acres.

35. It will perhaps be sufficient to answer to this question that no cultivation can be carried without well irrigation. Barani cultivation is purely of the catch crop order and yields no crop in three years out of five. Seed is sown on barani land very largely for the purpose of raising fodder.

36. See 35.

37. (1) The figures recorded about rent show that the percentage of the produce taken on barani land by the landlord is about 30 per cent., and that on chahi land is about 25 per cent.

(2) If my assessment proposals are accepted by Government, the revenue rate on barani land will work out at about 2 annas an acre, and that on chahi land at about 10 to 12 annas per acre. The chahi rates at present are paid on the whole well, irrespective of the area under crop. I have proposed a system whereby parts of the well which go out of work will be exempted from revenue. The rates referred to above will not, however, be assessed on the whole commanded area of the well, but only on the irrigated portion. The revenue thus obtained will be treated as a fixed demand on the well, which will continue to be collected until, as shown above, any part of the well goes out of work.

38. I do not think that serious difficulties of this sort are often encountered. I have not myself seen the construction of a well abandoned because the site selected proved to contain no water. Wells are easy enough to construct, provided one has the necessary capital.

No expert advice has ever been offered to the people on the subject, and I do not think that it would prove useful to offer it. The problem in the tract is not how to build, but how to maintain a well. For this reason I should also answer the question contained in No. 39 in the negative. There is no reason why Government should build wells when there are hundreds lying idle which cultivators can have for the asking.

40. Temporary wells are used for the purpose of watering flocks only. They cannot be used for the purpose of irrigation, and I see no need to encourage their construction.

(16) LALA MOTI RAM, Revenue Extra Assistant Commissioner, Multan.

A.—General.

1. My answers below refer to the Multan district, where I have been Revenue Officer and Extra Assistant Settlement Officer from July 1894.

Lala Moti Ram.

2. The average rainfall in each month of the year in the district is as follows:—

MONTH.	NAME OF TAHSILS.					TOTAL.
	Multan.	Kabirwala.	Shujabad.	Lodhran.	Mailsi.	
April	0.20	0.25	0.17	0.29	0.14	
May	0.26	0.19	0.20	0.15	0.32	
June	0.39	0.68	0.33	0.29	0.47	
July	2.10	1.83	1.21	1.41	1.11	
August	1.08	1.21	1.30	1.08	0.97	
September	0.69	0.69	1.23	0.41	0.46	
October	0.02	...	...	...	0.04	
November	0.01	0.02	0.09	0.06	0.06	
December	0.14	0.07	0.09	0.05	0.08	
January	0.32	0.37	0.20	0.43	0.18	
February	0.18	0.25	0.24	0.28	0.29	
March	0.47	0.41	0.31	0.49	0.07	
	5.89	5.97	5.87	4.58	4.10	

3. The only obstacle to the extension of irrigation is in the Mailsi tahsil from sparsity of population, but tenants from other tracts could easily be obtained when canal irrigation in the Bar tract is extended. The extension of the new canal from the Sutlej-cum-Bias is under the consideration of Government in this part of the district.

(2) But there is a sufficient or much larger stock of cattle even in the Bar tract for the cultivation of the irrigated land and other requirements.

(3) Usually the people of this district do not use manure in their lands which are irrigated by canals, but for well lands they do use it and there is enough of it in the whole district. Besides the manure of cattle, the roots of indigo plant are greatly used for manure and are very useful for cultivation of other crops.

(4) The soil is good throughout the district with the exception of a strip of land which commences from the south-west corner of the district in the Shujabad tahsil and traverses through Shujabad, Lodhran and Mailsi tahsils up to the Bar tract, but some part of it is already irrigated in the two first named tahsils and grows only rice. This land has got rich and will improve by the silt of a perennial canal.

(5) Uncertainty of the supply of water will certainly drive away the tenants to better canals, and its too late commencement will deprive the people from growing better crops, and if the water ceases to run earlier a good deal of the harvest will be returned as Kharaba causing loss both to the zamindar and the Government, but if there is enough water in the river there will be no such obstacle.

(6) There is no obstacle on account of lack of capital or of funds for more expensive cultivation of irrigated crops except in the Bar, where the Langrial and other tribes of a nomad kind inhabit the country, but they are rich enough in cattle and camels, and could easily get money whenever they require it. At present they only grow crops from which they could easily pay revenue or which would give them sufficient food for men and cattle, but there will be no difficulty whatsoever in getting tenants for the lands which mostly belong to Government.

(7), (8) and (9) There is no obstacle on account of fear of enhanced rent or revenue, nor on account of uncertainty of tenure or defects of the Tenancy Law, nor for any other reason.

4. The lands irrigated from wells constructed at the expense of private individuals with or without the aid of loan from Government are exempted from enhancement of revenue on account of the irrigation for 20 years from date

of construction. But if an old well out of use is repaired, the exemption extends to ten years from the date on which it is brought into use again. In this district, though a nominal fixed revenue is imposed on wells, it is not recovered if the well was not used during the year, and the assessment is only recovered if it has irrigated some part of the crops attached to the well during the year. Practically the revenue on wells is rather fluctuating and are exempted from payment of wet revenue for the period of 10 and 20 years above stated, as a *patta* is granted to them to that effect. Whenever a new well is constructed or an old one repaired, the Patwari of the village submits a report or sometimes the owner of the well himself applies for a protective lease and on enquiry through the Revenue Agency the protective lease is granted to such wells, which are then entered up in prescribed registers showing the date of commencement and the expiry of the period of protection. The existing provisions in case of wells are sufficiently liberal.

As for watercourses constructed at private expense, the following rules were lately sanctioned by Government for this district:—

(1) If a new watercourse is made with the sanction of Government at private expense or by aid of a loan granted under Act XIX of 1883, and the length of the watercourse from its head to the boundary of the land for the irrigation of which it is constructed is not less than half a mile, the irrigation done by that watercourse for the first two years is exempted from payment of canal advantage revenue.

(2) If a new cut is made from the river at private expense or by aid of a loan granted under Act XIX of 1883, the land irrigated by it is, subject to the conditions laid down in rule 1, exempt from payment of fluctuating mill rates for a period of two years.

(3) For an old watercourse or an old cut which is brought into use again at private expense or by aid of a loan granted under Act XIX of 1883 after being out of use for not less than ten years protection is accorded for one year on the conditions mentioned in Rules 1 and 2. The watercourses and wells are usually constructed by owners only and in a few places near Multan by occupancy tenants. Where this is done by occupancy tenants, the rents are not liable to be enhanced for 10 or 20 years on account of these improvements

Lala Moti
Ram.

made by tooonts. As far long kassis, extending 5 miles and over, are concerned, they should, I think, be exempted from payment of enhanced revenue for two years instead of two only.

5. (1), (2), and (3) The loans under the Land Improvement Act are freely taken by the people in the Multan and Kabirwala tahsils, where there are new settlers on the Sidhni Canal, but not in others. The reason why some people do not like to get advance from Government, but have resort to the money-lender is that in a district like Multan where there are inundation canals and the harvests uncertain, the zamindar can evade paying the Salukar when he is unable to pay, whereas he cannot evade to pay a Government instalment which results in the attachment of his property and recovery of the amount by other coercive processes. Very few tahsildars are inclined to recommend a suspension or partial remission of the demand. I would not recommend the reduction of the rate of interest which is not much, nor does the zamindar care much for it as he is paying much more to the *bania* gladly nor could I recommend the partial remission of interest. But I would recommend the more frequent suspension of the advance resulting in part remission if the harvest have failed continuously.

(4) I would also recommend the partial or total remission of the advance in case of failure of the attempt to obtain water if the zamindar has done his best and has also spent additional sum from his own pocket and is hard up.

(5) The repayment of the advances granted in this district extend over a period of about 12 years, nothing being realized for the first four or five harvests. I would in most cases extend the period of repayment to 20 years, which is optional with the Deputy Commissioner to do so under the rules, but officers usually allow ten years, as they think otherwise the interest would exceed one-third of the total advance; but I think it should be left to the discretion of the zamindar whether he would pay it within 10 or 20 years, and the latter period should be allowed if there is sufficient security for the repayment of the advance. But what is wanted is the leniency with which it should be realized when the zamindar is in difficulty, such as poor harvests, etc., so that he may not have to go to the money-lender, who usually charges him much more when he finds out that a process for recovery from the tahsil is out against the zamindar.

(6) I do not think any grants-in-aid are necessary, provided the realizations are made with some leniency and care.

6. The extension of irrigation certainly tends to injure the remaining cultivation by rain or pure wells by attracting the cultivators to irrigated tracts. I can quote the following instances connected with this district:—

(1) When the Sidhni Canal was constructed here in this district, a good many of the inhabitants of Bar and other tracts who were either tenants or proprietors of wells and barani lands left for the canal irrigated lands. So did most of the people whose lands were flooded by the rivers when the floods became less and uncertain.

(2) And now since the Chenab Canal has been constructed and extended most of the people and tenants of the Ravi *shaka* and even of the Sidhni Canal (which is an uncertain one) have deserted and left for the Jhang district where they act as tenants for others, and they sometimes return to their homes when there are floods in the river Ravi, which is perhaps once in five years. But nearly half of this tract is now to come under irrigation by the Chenab Canal, as there is a proposal to extend it up to the banks of the river Ravi, which is usually dried up for about six or seven months in the year. As regards the other half as well as the Bar tract, the matter seems hopeless until the projected new canal from the Sittlej is constructed, which the people pray that it might be done sooner. There is a strong desire evinced among the people of the district everywhere to have means of irrigation extended to it or increased, for the rainfall is very little to speak of and the cultivation merely depends on irrigation from canals or wells, but even the wells alone unaccompanied by canal water are useless as there is no rain, and much of the land is to

be taken up for fodder and saves very little for revenue and the zamindar's own support; and the consequence is that, when there is no rain, the people of the Bar and other tracts desert for the banks of the rivers and return only when there is abundant rain when they work their wells, for then they have grass in the Bar for their cattle.

Canals of intermittent flow.

12. Under this head I include the—

(1) Zamindars cuts or *ndās* from the river Ravi which is called Sidhni here owing to the straightness of the river and which gives the name to the series of canals dug up by Government at its own expense. Government has constructed and thrown a dam across the river Ravi near the head works of the Sidhni Canal and some of its subsidiaries. The river is often dried up or is too low, and hence the dam is of great use in keeping the water (whatever there is in the river) going into the canal. As the river itself is uncertain, so the supply in the cuts from the river or zamindars *ndās* is more uncertain, and even the dam constructed by Government for their big canal is of no assistance to them, for the land which they irrigate mostly lies to the north of the river on higher ground. It is only during the time the river is too high or in floods when the zamindars *ndās* run, but they always cease when it is low, which is the case in ten months out of twelve. The land being higher, it is not of much use to excavate these cuts deeper, for in that case the water would hardly reach their lands, and even if they do spend money in doing so, the water may benefit only a few lands which lie at the tail of the cuts which are very long.

(2) The water is dispensed to the lands by means of watercourses dug up from the canals or *ndās* at the expense of the owners, and the distribution of the water is in the hands of the owners jointly who irrigate their lands by turns and periods fixed by them according to the measure of their shares and recorded in the Settlement Records. And if they supply water to others, who are not shareholders in the *ndā*, then they realize half the proprietor's share of the produce as the price of the water for irrigation. This is called *afkahi* in this part of the district.

(3) The period for which the supply is maintained is quite uncertain. It might be for a day or for a month or may not run at all, and depends merely on the duration of floods.

(a) In an year of abundant rainfall and floods it may run for three or four months;

(b) in an year of scanty rainfall or little floods for a week only;

(c) in an year of drought they never run at all and the people leave for better places, taking with them their families and cattle, and the whole tract in such cases, though lying on the banks of the river at a beautiful spot, is desolate altogether.

Inundation canals.

Under this head I also include the Sidhni Canal, which was dug up by Government in 1885-86 and which was considered to be perennial, but as the river Ravi from which it derives its water is dried up in a greater part of the year, it is not better than the other inundation canals, if not worse than them. The canal sometimes runs usually from April to October, but in a year of drought when there is no rain in the upper districts, which have a prior claim to irrigation from the river, the canal does not run till June, and sometimes till July when the time for sowing the more valuable and useful crops has expired. The watercourses are cleared of silt by the zamindars under the supervision of Government officials, and the distribution of water is in the hands of Government. The supply of water is quite uncertain as the river can dry up at any time, and the cultivators are greatly disheartened and have very often to leave for the Cheoa Canal Colony. There is a consolidated rate of revenue classified according to crops and

includes both occupier's and water advantage revenue or owner's rate. The irrigation could be classed as of intermittent flow, but I have shown it under inundation canals, as unless there is sufficient water in the Ravi, the canal is dried up during a greater part of the year, and I have seen it running for three or four months only during years of drought.

13. The irrigation increases the value of the produce of land—

- (1) to double by rendering it possible to cultivate two harvests instead of one if the land is manured, otherwise to one and-a-half only;
- (2) to one and-a-half by substitution of more for less valuable crops or varieties;
- (3) and by increasing the yield—
 - (a) to one and-a-half in a year of ample rainfall;
 - (b) to one and a quarter in a year of scanty rainfall;
 - (c) to one and-a-half in a year of drought, for then the prices are usually higher.

14. The value of irrigation is diminished by—

- (1) the too late commencement of canals to $\frac{2}{3}$ ths.
- (b) to $\frac{2}{3}$ ths or even $\frac{1}{3}$ ths by the too early cessation of supply.

15. In the Multan district irrigation from canals is ordinarily supplemented by irrigation from wells to the same land in the rabi harvests, for the canals throughout the district inclusive of Sidhnai cease to run in October at the latest and land is only prepared with canal water for that harvest, but unless there is ample and continuous rainfall in the cold weather or wells are regularly worked up to March and sometimes up to beginning of April, the crops would not mature. The wells are usually not worked in the kharif where there is canal water except when a canal has ceased to flow from some cause in the middle of hot weather when the zamindar is obliged to work the well and try to save some of the crops which are often lost on account of the loss of irrigation from canals.

16. In the Multan district the cultivation and maturity of crops mainly depend on irrigation either from wells or from canals (more especially from the latter); and perhaps once in five or six years there is sufficient rain in the Bar tract (solely dependent on rain), where any crops are grown. In the third settlement just concluded the whole of the revenue, with the exception of small fixed sum on each well, has been allotted and given credit to the Canal Department. Properly speaking, there is no barani cultivation with which to compare the rate of produce and find out the net increase in the value of the produce due to irrigation as there is nothing without it. If the rains are ample, sorghum and bajra and jawar charri are sown in kharif and only wheat or some tarunira and turnips for fodder in rabi, but a greater part of the crop is often lost, and therefore I cannot take the produce of such lands into account, which may or may not give anything in a district with scanty rainfall. Hence the increase in the total annual value of the produce per acre due to the irrigation is—

- (1) Rs. 15 on the average of a normal of years, and
- (2) Rs. 20 in a year of drought, for then the prices are usually higher.

17. On the Sidhnai Canal there is a consolidated rate of revenue including both water advantage revenue and water rates, but on the other canals the water advantage rate is paid by proprietors and the water rates or occupier's rate by tenants. In answering this question I have separated approximately the water rate from water advantage revenue. Therefore the average annual rate paid per acre on account of irrigation—

- (1) by the cultivator or the owner of the land to the owner of the canal in the form of water rate is Rs. 2;
- (2) by the cultivator to the owner of the land in the form of enhancement of rent is Rs. 5;
- (3) by the owner of the land to Government in the form of enhancement of revenue, water advantage rate, owner's rate, etc., Rs. 1-8-0.
- (4) by owners of canal to Government in the form of royalty 2 annas in the rupee out of canal advantage revenue realized from others who are not shareholders of the canal, the shareholders of the canal being assessed with revenue, etc., in the ordinary way separately.

18. The private expenditure to bring the water to the field or to prepare the land for irrigation is generally incurred by the landlord in case of long watercourses exceeding quarter of a mile, but below that length is done by tenants who are allowed some concession in the rent for one or two years. The amount of expenditure depends on the length of the watercourse which is from quarter of a mile or less to about 12 or 13 miles in places and the owners have been allowed some deduction on this account in the fixed revenue. If the watercourse is cleared of silt and is long enough, the rate of rent taken by the owner from his tenants is half of the produce or even more, but when it is not long or when long and is done by tenants, then the rate of rent is one-third of the produce. The silt clearance charges of long kassias come to about Rs. 1 per acre of irrigated area whether incurred by proprietors or tenants, and whoever does it, has the benefit in the rate of rent as stated above.

19. As the supply from canals is only in the hot weather and as the holdings are larger, the people in this district cultivate their lands by rotation, i.e., only one harvest is usually taken from the land, and in case they cultivate two harvests successively they leave it fallow for some time. Except near towns and near wells where ample manure is used, both crops grow, but even there the crops are grown one year on one side and in the next year on the other side of the well. But in places near Multan, Keheror and Shujahd towns where there is little land attached to some of the wells, for one harvest out of every four, some part of the land is left uncultivated, though highly manured, so that sufficient rest is given to the land and hence there is no deterioration of any sort in the soil from irrigation, water-logging, etc. In places where there is salt efflorescence, it is rather decreasing by the silt that is brought in by the irrigation. My experience of the results of draining irrigated land is that it is very useful and essentially necessary.

20. The canals were maintained by means of ehher or statute labour by occupiers or tenants in the whole of the district except on the Sidhnai Canal, where from the commencement Government has done the whole of it and had realized the cost of construction of watercourses or kassias from the lessees of Government lands and other proprietors. The silt clearance of kassias or watercourses (and not the rajbahs or canals) is done by the proprietors, who also pay the water rate or occupier's rate which is included in the consolidated rate taken by Government from proprietors only and here the rate of rent is half the gross produce. Of the other inundation canals there is still the same system on the Sutlej canals (i.e., the ehher system); but on the canal from the river Chenab since the introduction of the third settlement Government has charged the tenants with occupier's rate classified according to the different crops, and has abolished the ehher system by undertaking to do everything connected with the canals; but the long and small watercourses are still done by the people (proprietors and tenants as the case may be), the annual cost of silt clearance of the canals comes to Rs. 1 per acre irrigated, which is in addition to the silt clearance of watercourses, which also costs about Rs. 1 per acre of irrigated land. On the Chenab Canal the occupier's rate comes to about Rs. 2 per acre of irrigated land. The occupier's rates are to be introduced also on the Sutlej canals from next year, and the ehher system will then be altogether done away with in the whole of the district. No further legislation is in my opinion required.

21. There were two big canals constructed by private persons in this district, in addition to small ones from the Ravi river, i.e., the Hajiwah and Gholamwah canals, both of which lie in the Mailsi tahsil which adjoins the Montgomery district. Owing to dispute between the proprietors on the Hajiwah Canal and difficulty caused to other irrigators, the canal was taken over by Government under its own management. The original proprietors here are charged only silt clearance rate and their land revenue is fixed, but the other irrigators pay water rates and water advantage rate just like what it is on the other canals. But on the Gholamwah Canal, owned by Gholam Muhomed Khan Donk'ana of Luddan there has been no such difficulty and the owners still manage the distribution of water and realization of the water rates out of which a fixed sum of Rs. 500 per annum is paid to Government as royalty. The proprietor pays canal advantage revenue and the other irrigators pay canal advantage revenue as well as water-rates (the latter to the owner of the canal).

22. I am not in favour of the construction by private persons of further canals, as there is no unity among the people and sooner or later they are sure to fall out and cause much inconvenience to the irrigators, which will lead to the interference by Government or taking over the canal under its own management.

Lala Moti Ram.

*E.—Wells.**Lala Moti Ram.*

34. The average depth of permanent wells in the different assessment circles is as follows:—

ASSESSMENT CIRCLE.	DEPTH		DEPTH		DEPTH		DEPTH		DEPTH		REMARKS.
	to	of	to	of	to	of	to	of	to	of	
	water.	water.	water.	water.	water.	water.	water.	water.	water.	water.	
	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	ft.	
Riverain or Hithar	12	17	23	17	20	9	17	17	22	8	
Uttar or middle of tahsil where canals can reach.	31	19	22	23	32	10	38	16	30	13	
Atraf (near the town of Multan).	25	22	...	...	...	...	...	...	...	...
Sidhnai Canal tract	38	19	...	...	45	13	...	...	...	...
Rāwā and Bar beyond the reach of canals or where canals can reach at great expense. }	43	11	40	11	58	10	44	7	{ 62 64	4 9	Other Rawa Bar.

(2) The supply is from percolation and they are not liable to fail or become too saline except in a few villages on the boundary of Shujabad and Lodhran tahsils, where they are already saline. There is a strip of land above mentioned about 4 or 5 miles in width where such wells exist in rich lands.

(a) and (b) In an ordinary year or even in a year of drought the supply is not diminished, but if a canal is dug up or ceases to flow in the vicinity, a change in the depth of wells usually occurs.

(3) The average cost of construction of the wells in different circles inclusive of wheels and other gear is as follows:—

Circles.	Multan.	Shujabad.	Kabirwala.	Lodhran.	Mallat.
Hithar	400	400	400	450	450
Uttar	500	500	500	550	550
Atraf, Multan	600	...	...	...	...
Sidhnai	600	...	600	...	...
Rawa	700	700	700	800	{ 800 other Rawa. 900 Bar tract.

(4) The average duration of a well is about 40 years.

(5) The water is usually raised by means of Persian wheels, which last for 8 or 10 years generally.

(6) The average area attached to, and commanded by, a well is about 50 acres.

(7) The average area irrigated by a well in any one year where there are also canals is 25 acres and near town of Multan it is about 20 acres, for the cultivation is dense and there are no fallows.

In the Sidhnai Canal tract also the area irrigated by a well aided by canals in a year is about 25 to 30 acres. But in all tracts where there are only wells and are not aided by canals, the area irrigated by a well comes to about 10 or 12 acres, and if there is ample rain, then about 20 acres are prepared with rain and cultivated and matured with well water.

35. (1) The irrigation increases the value of the produce by rendering it possible to cultivate in both harvests to about $1\frac{1}{2}$ or $1\frac{1}{4}$ where manure is used;

(2) and to about double by substitution of more for less valuable crops, or varieties in lands near towns and to $1\frac{1}{2}$ in other places;

(3) by increasing the yield—

(a) in a year of ample rainfall to $1\frac{1}{2}$;

(b) in a year of scanty rainfall to $1\frac{1}{4}$;

(c) in a year of drought no increase is expected, as more land is taken up for fodder.

36. An approximate estimate of the increase in the total annual value of the produce per acre due to irrigation is—

(a) In year of ample rainfall Rs. 10 per acre.

(b) Do. scanty " " 8 "

(c) Do. drought " " 6 "

37. Approximately the average annual rate per acre on account of irrigation paid—

(a) by the cultivator to the owner in the shape of enhancement of rent comes to Rs. 2-8;

(b) by the owner to Government in the shape of enhancement of revenue, Rs. 1-4.

These rates are paid on the area actually irrigated by wells during the year. This reply is with reference to the whole district, but near Multan the income comes to Rs. 15 per acre, and the tenant pays Rs. 3-12 to owner, who pays about Rs. 1-8 as revenue per acre.

38. (1) No serious difficulty is encountered in this district in the selection of a spot in which supply of water will be obtained;

(2) nor in the actual construction of the well.

No assistance has ever been offered by Government or local bodies in the shape of expert advice, trial borings, the use of boring tools or otherwise, nor do I think in this part of the country Government should give any such assistance, as the people very well know the spots where they should dig wells. There are many people who are expert and usually select better spots for others where they could find suitable sites with good water.

39. I am not in favour of the construction by Government of wells in land which is private property. The rules about the grant of tokari are quite sufficient in the way of aid in money to the zemindar for the construction of wells and other such works. The people do it cheaper and Government will only waste more money in their construction through contractors and others.

40. Temporary wells are not commonly used in this district except in the riverain lands on the banks of the river Chehab. They are not a great protection against drought, though they improve the produce of the crops in the rabi harvest. These are called kharoras and in case of a year of scanty rainfall the people dig them up if their lands are not already silted by the floods in the river. No special encouragement is necessary, as the people know their business better.

(17) Mr. Isa Charan Chandu Lal, Extra Assistant Commissioner, Fazilka.

I.

A.—General.

1. These answers relate to the Fazilka Sub-division of the Ferozepur district which includes the Fazilka and Muktsar tahsils. I have been in charge thereof for nearly two years.

2. The average monthly rainfall for the last ten years is as follows:—

Month.	Fazilka.	Muktsar.
January . . .	.84	.95
February . . .	.75	.87
March . . .	.17	.2
April . . .	.15	.05
May . . .	.49	.38
June . . .	1.13	1.43
July . . .	2.59	2.90
August . . .	2.33	3.35
September . . .	.85	1.80
October . . .	.08	.12
November . . .	.02	.Nil
December . . .	.13	.19
TOTAL . . .	9.63	12.33

3. There is no obstacle to the extension of irrigation from sparsity of population or insufficient supply of cattle or manure, etc.

The unsuitability of soil is a great obstacle. The tract under notice consists of three main divisions, i.e., (the Rohi upland), the Hithar (the tract along the Sutlej river) and the Uttar or intermediate tract.

The Rohi is commanded by the Sirhind Canal; the Hithar is served by Colonel Grey's inundation canals, or is subject to river floods and almost all the well irrigation is confined to the same tract, because the water is not too far from the surface and is not too saline. In both the Rohi and Hithar Circles there are some villages without any irrigation or with nominal irrigation only. In the former circle this is due to either the soil being too sandy, or too high for the canal level or to the village being at the tail end and so no water reaching it.

In the Hithar Circle this is chiefly due to the cultivators belonging to indolent classes who are devoid of all energy and enterprise. Well irrigation is practicable in all the villages of this tract and, lovely crops are grown by Armins and the hard-working Mahants or Daggars.

The Uttar or intermediate tract is almost wholly dry. Well irrigation is not possible as the water is too far from the surface and in the majority of cases bitter. In years of short rainfall the people have great trouble about drinking water for themselves and their cattle.

The country is very sandy, and there are sandhills all over, regular ridges in places. The extension of canal irrigation which is the only kind of irrigation possible becomes a difficult problem. As this tract is very insecure, the people would do and pay anything to get canal water.

The uncertainty of the supply of water in the river is also a great obstacle to the extension of canal irrigation.

I do not think that the fear of enhanced assessment is so much of an obstacle here as in the Montgomery district.

4. Land irrigated from works constructed by private capital is generally exempted from enhancement of assessment for twenty years. At a reassessment leases are given by the Settlement Officer, remitting the wet assessment for twenty years from the date on which the work began to be used.

I have not come across any irrigation work constructed by a tenant.

In the case of ordinary wells in this district I think this period of exemption is sufficient. In cases of works involving a considerable outlay the exemption might be extended, the period depending on the outlay.

5. I do not think that loans under the Land Improvement Act are very freely taken by the people. This is chiefly owing to the lack of energy and enterprise among them. I refer to loans for sinking of wells only, or no other irrigation works are within the competence of the agriculturists.

In famine years, people apply for those loans much more than in ordinary years, but the giving out of takavi is Punjab

is stopped, all the available money being needed for loans for purchase of seed and bullocks. I am strongly of opinion that loans, under the Land Improvement Act, should be freely given in famine years also, as it is then that people feel the need of extending irrigation. I do not think any reduction of the rate of interest is needed. The Zemindar is accustomed to paying much higher rates. The period of repayment is also sufficient in cases of ordinary loans for wells not exceeding Rs. 400. The payment of Rs. 20 per annum plus interest on an average is not too heavy in average years. In bad years, if the instalments are remitted, it would tend to relieve the people and encourage taking loans. I would also recommend total remission in cases of failure to obtain water, or when the water is found to be too saline for use. Grants-in-aid would come in handy where a man's capital has been exhausted before completion of the work.

In the Ferozepur district the extension of irrigation does not tend to injure the remaining cultivation. The cultivation in the dry tracts is mostly by landlords themselves and even among tenants there is a large demand for land.

There is a very strong desire among the people of the unirrigated villages for extension of canal irrigation to their lands.

B.—Canals of continuous flow.

7. On the Sirhind Canal there is not much double cropping, neither much growing of valuable crops. Sugarcane, cotton, rice, etc., are very rare, and the principal canal irrigated crops are much the same as the rain crops.

This is due to the soil being too sandy and the Satlo water having hardly any fertilising silt.

In a year of ample rainfall, I doubt if the yield on canal irrigated land is better than that on dry land. Very often the reverse is the case. This is chiefly due to the nature of the soil and also to the fact that the barani lands get rest now and then.

In a year of scanty rainfall the yield is very much increased by the canal irrigation. Double or even treble is not an excessive estimate.

In a year of drought there is no yield on dry lands, but at the same time I have observed very poor crops on the canal irrigated land, the amount of water in the canal being quite insufficient to give the necessary number of waterings, still there is a good deal of fodder for cattle and food for man.

8. Roughly I think the average increase in the total annual value of the produce due to the Sirhind Canal irrigation is about double and may extend to even fourfold in villages which get a good supply of water.

In a year of drought no comparison is possible, there being no dry crops.

9. (1) The occupier of the land pays on an average about Rs. 3-4 per acre to the Government as water rate.

(2) The cultivator pays to the owner in kind at rates which in no case exceed the dry rates. The prevailing rate is one-fourth, the tenant paying the water rate as well. At a rough estimate I would say the tenant pays the owner about Rs. 3 per acre on the area of matured crops for canal irrigated land.

(3) At present no canal advantage or any other enhancement of revenue is taken by Government from owners.

10. The village water-courses are maintained and cleared by the owners. The expense on a perennial canal is not much. The small channels for irrigation of fields are maintained and cleared each harvest by the tenants.

The little labour involved is recovered from the harvest concerned.

11. There is no over irrigation or water-logging on the Sirhind Canal. The nature of the soil is opposed to this.

I have not observed any deterioration of the soil, in fact the loose sand has been hardened and improved by the canal irrigation which is only about 15 years old now.

C.—Canals of intermittent flow.

12. The answer to this question is the same as given for the Montgomery district.

13. The soil of the riverain tract being a rich loam double cropping is general. Rice is always followed by gram; mung and chauli are often followed by wheat or wheat and gram.

Mr. Isa
Charan
Chandu Lal.

Mr. Isa
Charan
Chandu Lal.

Valuable crops are largely grown, engarcane, rice, cotton, tobacco, vegetables, etc., are grown in almost every village.

Both these facts increase the value of the produce of land considerably, say about four times.

(3) In a year of ample rainfall the yield on canal irrigated land is not more than on dry lands. Water-logging and excessive moisture injure the crops. In years of scanty rainfall and drought the yield is much more if the canals give a supply of water in September.

14. The answer to this question is the same as in the case of the Montgomery district.

15. Well irrigation in this tract is only possible in the area commanded by the inundation canals and reolders canal irrigation more secure in years of scanty rainfall. In years of drought where there are no wells, the canals do nothing.

I consider it essential to increase the number of wells and thus render the tract quite secure.

16. On the average of a normal term of years I think the increase in the total annual value of the produce due to this irrigation is about double, or say about Rs. 16 per acre as compared with Rs. 8 per acre on dry land.

In a year of drought no comparison is possible. There is no produce on dry land, and there may be none on the canal irrigated land as was the case in 1899-1900.

17. (1) The average rate paid by the occupiers to the Canal Department is about one rupee per acre.

(2) The cultivator pays the owner in kind, the enhancement due to the irrigation being roughly estimated at Rs. 2 per acre.

(3) In the Muktsar tahsil the Government takes canal advantage revenues at fourteen annas per acre on superior crops and seven annas on inferior crops, or an average of about ten annas per acre.

These rates are all paid on areas of matured crops.

18. The village water-courses taking from the canals are maintained and constructed by the owners. The small channels for irrigating fields are constructed and maintained by the tenants. The former cost a good deal, but I cannot give the figures. The latter only require some manual labour, and this is considered as an ordinary requirement of agriculture.

19. The Arains are the agriculturists who believe in manuring fields. The others only manure the fields close to wells or near village sites. The inundation canals contain some silt in the water and manuring is not absolutely necessary unless two crops are taken. I think double cropping should be discouraged by putting penal rates on the second crop.

There is a good deal of water-logging and too profuse irrigation. The heads of the village water-courses are *kachcha* and open, and so the supply of water cannot be regulated. Low-lying villages get flooded and the higher ones suffer from a scanty supply. In my opinion much more control on the water is needed. All water-courses should have masonry heads with regulators and every effort should be made to prevent over-irrigation on the one hand and deficient irrigation on the other. Over-irrigation naturally makes the climate unhealthy.

20. I cannot answer this question.

21. All the inundation canals of the Ferozepur district are private canals, owned by the Zemindars, but were constructed by Colonel Grey as Deputy Commissioner and have always been managed by the Canal Department officers by Government servants whose services are transferred; under these circumstances no trouble incident to ownership by private persons have arisen.

22. I am not in favour of private persons constructing canals. As stated with regard to the Montgomery district, I think District Boards should construct and manage district canals.

E.—Wells.

34. The riverain tract or Hitbar Circle is the only one in which irrigation from wells is practicable.

The average depth to the surface of the water is about 24 feet.

The supply is from springs. The average cost of construction is about Rs. 200.

The average duration is about thirty years.

Water is invariably raised by Persian wheels.

The area attached to a well varies considerably and depends on the land owned by the owner of the well. The area commanded by a well varies similarly but 40 to 60 acres can be commanded and about 25 acres irrigated in one year.

35. Well irrigation increases the value of the produce of land considerably both on account of double cropping and substitution of valuable crops for poorer ones. The yield is also increased in years of ample and scanty rainfall and drought as well.

36. If the average outturn of dry lands be assumed at about Rs. 5 per acre, that of well irrigated land may be taken at Rs. 20 per acre on the average of a normal term of years, and about Rs. 30 per acre in years of drought, but in the latter case the area of crops is much reduced.

37. Cash rents do not exist. The tenants pay the owners in kind and the rate is lower than those on canal irrigated or unirrigated lands and in addition no fodder is given. Roughly speaking the tenant pays the owner about Rs. 2 per acre in the shape of enhancement of rent.

The owner pays the Government about 12 annas per acre in the shape of enhancement of revenue.

The rent is paid on area of matured crops and the revenues on average well irrigated area.

38. I have not observed any difficulties being encountered in the selection of a spot or in construction of a well. No advice or assistance is rendered by Government or local bodies. The latter should assist where necessary.

39. On the whole, I am not in favour of Government constructing wells in private lands. Where the agriculturists are hardworking and believe in working wells, loans on favourable terms, low assessments and remissions where necessary are sufficient. Where the cultivators are indolent and avoid well cultivation it would be throwing away money presenting them with wells.

II.

40. Same answer as I have given about the Montgomery district.

(1) The following answers refer to the Montgomery district, where I was Assistant to the Settlement Officer for seven and-a-quarter years:—

(2) I cannot give the average monthly rainfall, but the annual average is about 8 inches.

(3) The only obstacles to the extension of irrigation from inundation canals are:—

(a) the want of water in the Ravi river;

(b) shortness of water-supply in the Sutlej river;

(c) want of enterprise in the people;

(d) lack of interest in the officers and the great trouble and delay experienced in getting proposals sanctioned.

As regards well-irrigation the chief obstacles to its extension are—

(a) The labour and expense of well cultivation.

(b) The very high assessment as compared with dry assessment generally put on wells.

(c) Lack of tenants for wells.

(d) The precariousness of the rainfall as unaided wells in years of drought can just supply food for the well cattle.

In the above answer by well irrigation I mean pure unaided well cultivation. Where wells are sunk in canal irrigated or river flooded tracts, they do very well in every way.

4. Land irrigated from works constructed by private capital is generally exempted from enhancement of assessment for twenty years. At the time of a re-assessment, leases are granted to persons who have sunk wells remitting the wet part of the assessment for 20 years from the time the well was brought into use.

I have not come across any well constructed by a tenant ordinarily, I consider this period of 20 years sufficient. In cases where the outlay is very considerable, this period might be extended to 30 years.

5. Loans under the Land Improvement Act are not as freely taken by the people as they should be. This is chiefly due to the cumbersome procedure which involves the application passing through the hands of so many petty officials, and partly to the fear that the instalments will be exacted even when the debtor cannot pay. Ordinarily I think the rate of interest is low enough and is not felt as a

burden. I would freely suspend or even remit instalments when adverse seasons or other calamities cripple the resources.

I think it will make these loans more popular if the Government generally remits the whole amount in cases where the well fails or comes out saline and therefore unfit for use.

The people who apply for loans from Government are those who have no money of their own and repayments are made out of the income derived from the well so sunk. If this is a failure, repayment can only be made by mortgaging or selling the land.

In ordinary cases the 20 years' period for repayment is sufficient. In cases of very large amounts this might be extended to 30 years.

Grants-in-aid would come in handy in cases where a man starts with enough capital, but where the costs exceed the estimate and the capital in hand.

6. In tracts (like Montgomery) where the owners have more land than they can manage, and there is scarcity of tenants, extension of canal irrigation attracts the cultivators who desert wells and dry lands.

The recent colonisation on the Chennai Canal caused the desertion by tenants of wells and dry cultivation along the Ravi, necessitating a revision of the assessment and extension of fluctuating assessment.

The people all over pray for canals. In Montgomery they were most anxious for new inundation canals, showed no places whence the canals should be taken out and the tracts they would command.

B.—Canals of continuous flow.

There are no perennial canals in the Montgomery districts.

C.—Canals of intermittent flow.

12. The inundation canals in the Montgomery district are taken out from the Sutlej and Ravi rivers. The former are managed by the Public Works Department, the latter by the District Board. All have *kachcha* heads, and the water comes in when the rivers rise about the end of April.

(2) The water is distributed to the land by means of village water-courses which are generally taken out from the canal a long distance off. In the village itself there are small channels taking out of the water-course and reaching all the fields.

(3) In a year of ample rainfall the canals flow from the end of April to the end of September; in a year of scanty rainfall for about four months, from June to September; in a year of drought from six weeks to two months in July and August.

13. In Montgomery there is hardly any dry cultivation.

There is a good deal of double cropping on canal irrigated lands. Rice is always followed by grain. Where wells aid the canals, wheat follows maize. Cotton is grown extensively on account of the canal irrigation and is a valuable crop, and would be non-existent but for the canals. Wells, however, render valuable aid. If the water in the canals is later than 15th May, cotton sowings are carried on with well irrigation.

I doubt if canal irrigation increases the yield in a year of ample rainfall. In such years I have often found dry cultivation to be superior to canal irrigated cultivation in the matter of yield.

In a year of scanty rainfall the yield of dry crops is very poor, and that on canals very good. Roughly the latter may be four times the former.

In a year of drought, there is no yield on dry lands. That on canals generally ends in straw for the cattle, and perhaps some grain, but very little, unless aided by wells.

14. The value of irrigation is diminished about one-third by too late commencement, as this only means no sowings of the early crops like cotton.

Too early cessation is fatal and all the value is lost, as all the autumn crops perish and no spring crops can be sown.

15. The irrigation from inundation canals is largely supplemented by wells, and I consider this necessary for years of scanty rainfall and drought. I would call a tract served by inundation canals secure only if it has a sufficient number of wells.

5 Punjab

16. On an average of a normal term of years, I should say the increase in the annual value of the produce caused by irrigation from an inundation canal only unaided by wells is about double. In a year of drought it is nil, except some straw for cattle.

17. I cannot give these figures as I do not remember them.

18. No expenditure is incurred in bringing the water to the fields from the village water-course or in preparing the fields for irrigation.

The tenants always clear the distributing channels and prepare the fields. This is done each season and is considered one of the ordinary requirements of agriculture. The tenant is reaped from the crop. The village water-course is dug and cleared each season at the expense of the landlord. The expense varies with the length of the water-courses.

19. The people do not generally use manure, except in the fields adjoining the villages where the most valuable crops are grown.

The supply of water is not regulated. Water-courses with *kachcha* heads cannot be regulated, and too profuse irrigation results.

The lands on the older canals like the Khanwah and Upper Sohag have deteriorated and crops are poor.

I would regulate the water-supply by insisting on masonry heads for all water-courses and double cropping should be discouraged unless manuring is resorted to. In fields not manured, double crops should pay penal rates. I have no experience of draining irrigated land.

20. I cannot answer this question.

21. There is one canal constructed by a private individual, viz., the Mohadi Khan Canal. So far as I am aware no trouble has arisen about realisation of water rates, as the owners of the canal would stop giving water to villages which did not pay up.

There were frequent complaints about supply of water to other villages through which the canal passes. The owners of the canal of course took as much water as they needed for their land and only the surplus was given to the remaining villages.

It has been recommended that after the lapse of the twenty years' contract the Government should take over the canal, so as to enlarge its scope and provide more water for the other villages.

22. I am not in favour of construction of canals by private persons. They seldom can be without official assistance. Acquiring land in other villages, regulating rights, distribution of water and levy of rates, etc., cannot be managed by private persons. The District Boards, in my opinion, should attend to this matter. Construction of short canals or irrigation channels is a very legitimate undertaking for these bodies, and they represent the agricultural body of the district and the revenue officers; and would be able to manage and control district canals.

D.—Tanks.

There are none in the Montgomery district.

E.—Wells.

34. (1) The depth of permanent wells in the Ravi and Sutlej valleys varies from about 20 to 40 feet, as far as I can remember. On the uplands (watersheds) it varies from 60 to 80 feet.

(2) The supply of water is from springs, and I have not known it to fail quite or become saline in the severest drought.

(3) The average cost of construction in the valleys is about Rs. 300 and in the uplands about Rs. 1,000. The upland wells are chiefly used for drinking.

(4) A well made well would last more than 40 years; average duration about 35 or 40 years.

(5) The water is raised by Persian wheels.

(6) The average area attached to a well is about 50 acres.

(7) The average area irrigated in any one year is about 20 acres.

35. (1) On wells double cropping needs manure and about 8 acres are on an average double cropped and manured; valuable crops like onions, tobacco, melons, etc.,

Mr. Jas
Charan
Choudhury Ial.

Mr. Isa
Charan
Chandu Lal.

being grown as the extra crop. This raises the value of the produce considerably, but a good deal depends on the class of cultivators. Arains, Mahtams, Jats, etc., make well irrigation very paying and grow sugarcane also. Walas, Kharals, Joyas and the like do not like hard work, and so do not make much out of their wells.

(2) Well irrigation results in the substitution of valuable crops like sugarcane, cotton, wheat, vegetables, etc. The poorer crops are not sown on wells, except for fodder in years of drought.

(3) The yield is always improved by well irrigation. In a year of ample rainfall about 50 per cent., in a year of scanty rainfall about treble and in a year of drought the fodder for the cattle and grain for the men keep matters going where in dry lands there is nothing and people migrate.

36. Roughly speaking the increase in the annual produce due to well irrigation is about three times, but the net profits could not be more than double as the expenses of keeping a well going are heavy.

In a year of drought there can be no comparison as dry lands produce nothing.

37. The cultivator pays a share of the produce to the owner and this share is always less than that paid on dry or canal irrigated lands and no straw is given to the owner from well irrigated land.

(2) The owner pays to Government on an average twelve annas per acre as enhancement of revenue. The ordinary dry rate being about 8 annas per acre and the average rate on well irrigation about Rs. 1.4 per acre.

These rates are paid on the average area of crops matured.

38. As far as I am aware no difficulty has ever been experienced in getting a supply of water.

In some parts, however, there is a deep stratum of sand and a firm foundation has not been found for resting the cylinder upon. One tract like this near Atares gave a good deal of trouble and several wells sunk fell down in one or two years.

No assistance has been given by Government or local bodies. In places like the above such assistance would be very valuable and welcome. The District Boards could assist in this matter.

39. In the Montgomery district I cannot recommend construction of wells by Government, the people generally shirk cultivation on wells, and if sunk by Government they may not be used. This applies to the Ravi tahsils.

In the Sutlej tahsils the people themselves have sunk some and would sink more if wells were assessed more lightly.

In working out our net assets we only take into account expenses which are recorded. There are other heavy expenses which are not taken into account. For instance, repairs of well, renewal of wood work, takari loans made by owners to tenants and never recovered are not taken into account. The large amount of wheat and other crops which are cut green as fodder and used for the cattle are also not fully allowed for. The result is that on an average of years the landlord derives less profits than we assume, and so the assessments on wells are higher than they should be in dry districts like Montgomery.

40. Temporary wells can only be used near the rivers where water is not far from the surface. I observed a great many sunk in such tracts whenever the river floods failed. They are a great protection against drought and the only encouragement needed is not to assess them higher than at dry rates. In fact in times of famine no revenue at all should be demanded.

(18) SHAIKH AZIZ-UD-DIN, Revenue Extra Assistant Commissioner, Hoshiarpur District.

A.—General.

Shaikh Aziz-ud-din. 1. The answers refer to the Hoshiarpur district, where I am employed as Revenue Extra Assistant Commissioner, since last four years.

2. The average rainfall in each month is as below:—

April	0.56
May	0.95
June	3.31
July	9.79
August	8.88
September	4.87
October	0.42
November	0.07
December	0.40
January	1.83
February	1.46
March	1.38
TOTAL	34.42

3. (1) } No.
(2) }
(3) }

(4) Yes, but there is one defect that the Kandi and hill lands, owing to their unevenness are not suitable for irrigation and also the water in these tracts is found at such a depth that a well costs hundreds of rupees and still the purpose of irrigation is not attained. The plain tracts are generally sandy and subject to oho action. Experience shows that sandy lands are not suitable for irrigation.

(5) }
(6) } No.
(7) }
(8) }
(9) }

4. Such lands are exempted for twenty years.

In tahsil Dasoza the lands which are irrigated by drains constructed by Zemindars are assessed at *barani* rate.

I think there is a tendency to grant exemption from enhancement only in cases where wells or large drains have been undertaken. The exemption should extend to all works, but the failure is more on the part of the officers assessing than in the rules.

A. ANDERSON,
Commissioner.

The 22nd January 1903.

In the case of lands irrigated by wells.

There is, I think, a defect in the law as to compensation to be paid by landlord to occupant tenants, but it is in favour of the tenant sinking the well.

A. A.

5. No, vide answer to question III (4). Wells serve their purposes only in the Sirwal Circles where there are already sufficient number of wells. New wells are being sunk to some extent at the expense of the Zemindars, and there are very few who obtain loans from the Government for this purpose. So far as this district is concerned, I cannot suggest any measures for the encouragement of these loans.

(1) }
(2) } No remarks.
(3) }
(4) }
(5) }
(6) }

The population is dense in Hoshiarpur.

A. A.

6. No, as far as I think not, but the people of this district are in no way against the extension or increase.

B.—Canals of continuous flow.

7 to 11. There is no such canal in this district.

C.—Canals of intermittent flow.

12. This has already been replied to by the Manager of Shah Nahr Canal in his evidence before the Commission at Lahore.

13. (1) In the proportion of 2 to 3.
(2) Ditto.

- (3) (a) Nil.
(b) In the proportion of 2 to 3.
(c) Ditto 1 to 2.

14. Vide answer to No. 12.

15. No.

16. (1) In the proportion of 2 to 3.
(3) Ditto 1 to 2.

17. (1) Rupees 1-2-0 per ghumaon is paid as water rate by the owner.

(2) Rs. 2-4-0.

(3) Rs. 2-4-0.

(4) Nothing.

In each case the rate is paid on the area actually irrigated and harvested during the year.

Such labor is considered part of the ordinary husbandry of the tenant.

18. Manual labor by the tenants without any security.

19. No damage results to the people, but the soil is deteriorated from irrigation without manure. Too frequent or too frequent irrigation damages chiefly the low lands and the water-logging makes the land unculturable.

20. Vide answer to No. 12.

21. It is a private canal managed by the Government since 1820-01. For further particulars see evidence of the Manager taken before the Commission.

22. Yes, by assisting private persons in obtaining land and in case of demand by loans.

D.—Tanks.

23 to 33. There is no such tank.

E.—Wells.

34. (1) Sirwal, 10 to 14 feet; Bakar and Jhingar, 15 to 25 feet.

(2) Generally from porcolation.

(a) Seldom liable to fail.

(b) Do. do. but water-supply decreases.

(3) In Sirwal from Rs. 200 to Rs. 300.
In other circles Rs. 300 to Rs. 500.

(4) Thirty to fifty years.

(5) By means of Persian wheels and charsa. Charsa is much resorted to.

Questions evidently not understood. A. A. (6) In Sirwal 10 to 20 ghumaons and in the rest of the circles from 5 to 10 ghumaons.
(7) Nil.

35. (1) } In the proportion of 2 to 3.
(2) }

(3) (a) Less than barani.

(b) In the proportion of 2 to 3.

(c) Do. 1 to 2.

36. (1) In the proportion of 2 to 3.
2. Do. 1 to 2.

Chahl area is assessed that is, area commanded, not necessarily irrigated; but chahl rate takes into consideration the fact that the whole is not irrigated year by year.

A. A.

37. (1) Double of barani.
(2) Nearly do.

38. (1) Yes.

(2) Yes.

No assistance has to my knowledge been offered either by the Government or by the local bodies in the shape of expert advice, trial borings, etc.

39. No, I don't think the Zemindars would like the interference of Government in their private property.

40. Yes, to a very large extent chiefly in years of drought: no encouragement is needed as Zemindars voluntarily sink them.

(19). LALA BISHAMBER DITAI, Revenue Extra Assistant Commissioner, Umballa.

Wells, Amballa District.

This district is usually described as submontane, and the description is correct enough as regards the Rupar, Kharar, Naraingarh and Jagadhri tahsils, which are all bounded by the Swalik range and in part include a considerable area of hilly country. The soil in these tahsils is generally speaking good alluvial loam. The southern portion of the district, including a large part of Amballa and some scattered blocks of villages in Kharar, Naraingarh, and Jagadhri is poorer in quality, and stiff clay soil is the rule there.

The district may be divided into the following parts:—

- (1) The large area of true hilly country in tahsil Naraingarh known as Morni situated well within the hilly range.
- (2) The long strip of hilly or broken ground lying in or under the Swalik range known in Rupar, Kharar and Naraingarh as Ghar and in Jagadhri as Kundi.
- (3) The large tracts of more or less level loam which is called Dhayn in Rupar, Seoti in Kharar, Naraingarh and Amballa and Bangar in Jagadhri.
- (4) The riverain tracts lying along the Sutlej in Rupar and called Brit and along the Jamna and the Sonc rivers in Jagadhri and called Khadir Circle.
- (5) The large tracts of stiff clay soil known as Bakar in Kharar, Naraingarh and Amballa, and as Dhar in Jagadhri.
- (6) The small Naili tract of Kharar comprising a cluster of villages irrigated from the Ghaggar.
- (7) The small tract called the Charsa Circle in which good masonry wells are common and highly profitable.
- (8) The large tract of the broken ground in the centre of the tahsil which is known as Darar Circle, Darar being the local name for land hopelessly cut up by deep ravines.

There are practically no wells in the Morni, the Ghar and the Darar where the water bearing stratum is not favourable to the construction of masonry wells. It is at such a great depth as to make the cost of making a well prohibitive.

In the Naili in Kharar, the Bait in Rupar, and the Khadir Circle in Jagadhri, it may be said that wells are cheap to make and easy to work, but are little needed and used. In the Amballa tahsil in particular there is below the clay soil a light sandy shifting stratum giving a very deficient water supply. Where the surface soil is thin it is liable to sudden subidence. Elsewhere and to a less extent beyond the limits of the tahsil the shifting sub-soil makes it impossible to sink irrigation wells which can be worked efficiently for more than a few years. Some of those which exist are kept as a last resource for years of drought, and if used persistently would soon break down. These remarks do not apply in the Dhayn and Charsa Circles where a large area is practically secured by wells which are good and are profitably used.

With these preliminary remarks, I now proceed to give answers to the questions set by the Irrigation Commission in respect of these tracts where masonry wells exist and where they can be made.

1. The average depth of permanent wells—

It is:—

In the large tract of light loam.	40 feet in Dhayn in Rupar.
	26 " Seoti in Kharar.
	28 " Charsa in Kharar.
	33 " Seoti in Naraingarh.
	24 " Bangar in Jagadhri.
In the riverain tract.	33 " Seoti in Amballa.
	30 feet in the Sutlej Bait of Rupar.
	8 feet in the North Jumna Khadir of Jagadhri.
	10 feet in the South Jumna Khadir of Jagadhri.
	10 feet in the Sonc Khadir of Jagadhri.

Shahk
Aziz-ud-din.

Lala
Bishamber
Ditai.

Lala Bishamber Diyal.	In the large tract of stiff clay soil.	30 feet in Chak Dakar of Kharar.
		33 " " " " Naraingarh.
		25 " " " " Jagadhri.
		33 " " " " Amballa.

2. The nature of the supply whether from springs or from percolation.

The supply is from springs—

in Dhairya of Rpar,
in Charas of Khorar,
in Seoti of Kharar,
in Dakar of Kharar,
in Bengar of Jagadhri,
in Khodir Circles of Jagadhri,

and it is from percolation—

in Seoti of Naraingarh,
in Dokar of Naraingarh,
in Dakar Amballa of Amballa.

In Amballa, Seoti and Dakar Mollana the supply of water is from springs in villages which are near the beds of hill streams, while it is from percolation in those villages which are far removed from those beds.

The spring wells generally give sufficient water in ordinary years, but the supply becomes deficient in years of continuous drought.

The percolation wells almost entirely fail in years of drought.

The well water in this district never becomes saline.

3. The average cost of construction—

It is Rs. 400	{	in Dhairya of Rpar,
		in Seoti of Kharar,
		in Dakar of Khorar,
		in Dhair of Jagadhri,
		in Seoti and Dakar Circles of Amballa,
Rupees 300	{	in Bait of Rpar,
		in Khodir Choks of Jagadhri.
Rupees 500	,	in Charas of Kharar.
Rupees 500	.	in Seoti and Dakar Circles of Naraingarh.

4. The average duration of a well—

The masonry wells are generally permanent and last for not less than 100 years or even more if periodically cleared off and repaired when needed.

5. The manner in which water is raised.

The usual method is to employ leather buckets with thick ropes called *charas* and *laos* respectively. Many of the wells are worked by one bucket drawn by a pair of bullocks, but in Dhairya and Charas Circles there are many wells which are large enough to be worked by two *charas* and *laos* and are called *dalwa* wells.

6. The average area attached to and commanded by a well—

Generally it is 10 acres, but in the Charas Circles of Kharar it is 14 acres, and in the Amballa tahsil it is only 5 acres.

7. The average area irrigated in any one year—

Generally it is about 7 acres, but in the Charas Circle on Dolawa wells it is about 10 acres and in the Amballa tahsil only about 4 acres a day. Half of the total area attached to a well is generally irrigated from a well when needed.

8. The increase in the value of the produce of land irrigated from a well—

(1) Lands irrigated from a well always give both kharif and rabi crops. But the land bringing sugarcane in kharif does not give a second crop in rabi.

(2) Only valuable crops are grown on well irrigated lands, viz., generally wheat and poppy in rabi and sugarcane in kharif.

But in years of scanty rainfalls or of drought when fodder is scarce maize and *chari* are also grown in kharif and barley in rabi in some lands.

(3) Ordinarily well irrigation is used for small plots of garden cultivation in the lands of Malis and Sanis. It is only in the years of scanty rainfall or drought that masonry wells are worked for their full extent, but owing to the weakness of men and cattle due to hard work and the

deficiency of water in the wells, it is hardly possible to give sufficient water to all the crops sown with the help of irrigation at proper intervals and the result is that the yield is not more than the yield of a good *barani* land in one ordinary year. But well irrigated crops in the years of ample rainfall must be double of the *barani* crops.

9. Rates of rent and revenue—

Division of produce or *bata* is the most common method of payment of rent by a cultivator to the owners of lands and the rate of *bata* remains the same whether the crops are *barani* or are irrigated. Cash rents where previously paid do not change with subsequent irrigation. In some places for irrigated land one double of those for *barani* land.

As regards land revenue, the well irrigated areas, as assessed, covered only so much land as was ordinarily irrigated by wells on an average of three years in all tahsils but Jagadhri, and on an average of four years in Jagadhri irrespective of the areas entered as *chahi* in the records prepared at new assessments.

In some cases assessment in well irrigated lands was deferred on account of protective leases for wells.

The rates of revenue on irrigated lands were:—

Irrigated, per acre.	Barani, per acre.
2 8 in Amballa Dakor Circles	1 0 0
4 0 in Amballa Seoti "	1 7 6
4 8 in Seoti Circles of Kharar	2 0 0
	1 10 0
4 0 in Dakar "	1 4 0
3 8 in Charas "	1 8 0
5 0 in Bet Circles of Rpar	2 2 0
3 12 in Dhairya Circles of Rpar	1 12 0
3 0 in Seoti of Naraingarh	1 8 0
2 8 in Dokar of "	1 6 0
3 12 in Dhair of Jagadhri	1 6 0
3 12 in Bengarat "	1 6 0

Assessment of these rates was fixed for the term of settlement, and if a well falls out of use it cannot be remitted during the currency of settlement. Similarly a new well cannot be made a ground for an addition to the assessment during the currency of settlement.

10. Truly speaking well irrigation is not easy in this district. It is laborious as well as expensive to make and work wells, and as drought is only occasional the easy thrifty men can do well without a well. It is only in the Dhairya and the Charas Circles that sturdy Jats put his savings freely into well construction and the purchase of expensive bullocks to work it out.

The cultivators generally know where the supply of water will be obtained and they have no serious difficulty in making a selection. But as the cost of constructing a good masonry well is generally high, the people generally do not hazard on an experiment which may fail. The Government or the Local Bodies have never offered any assistance in the shape of expert advice, trial borings and the use of boring tools and no assistance has ever been asked.

I do not think that assistance of this kind would lead to an appreciable increase of irrigation.

The State has, however, in times of drought and also in other years, offered to give takavi loans for construction of wells, but only a few persons now and then take these loans in ordinary years. In years of drought, however, a large number of persons take loans for the sinking of *kachcha* wells.

11. I am not in favour of the construction by Government of wells in land belonging to private persons because the water bearing stratum is not favourable to the construction of masonry wells and as drought is only occasional the agriculturists generally do well without irrigation.

12. *Kachcha* wells cannot be dug in the Charas and Neli Circles of tahsil Kharar, the Ghar Circle of Rpar, and the Merni hill circle of Naraingarh. These wells can be made in all other parts of the district in low-lying lands near the beds of hill streams. But as they are not needed in the Bet and Khodir Circles where land is irrigated by river floods no *kachcha* wells are made in these Circles.

of the *kachcha* wells are in chaks Seoti and Bangar. In ordinary years only such classes of agriculturists as Malis, Sainis and Arains make these wells for irrigating the vegetable and poppy crops. But in years of drought all classes of land-owners and tenants make *kachcha* wells wherever possible.

In villages in which *kachcha* wells are sunk water is generally found at a depth of 15 feet, the water in the wells being about 5 feet. The cost of constructing a *kachcha* well is about Rs. 10 for the *Jhao* work and the water lift as the zemindars do the digging themselves. This was the amount granted as *takavi* for each *kachcha* well during the late scarcity.

In average years there is no necessity for a loan for construction of *kachcha* wells, but in time of drought when the poorer classes of agriculturists are in straitened circumstances such loans are very necessary, and should liberally be granted. One *kachcha* well can irrigate about one acre in a day, and a man who is able to sink several such wells in a year of drought can grow a fair quantity of grain and fodder without much difficulty.

Wells—Delhi District.

For administrative purposes the district is divided into three tehsils—1. Ballabgarh, 2. Delhi, and 3. Sunipat.

Ballabgarh and Delhi are divided into the following assessment circles which have practically the same characteristic features in both the tehsils—

- (1) *Khadir-Bangar*. It lies along the river Jamna. Some villages are purely Khadir and some are partly Khadir and partly Bangar. The Khadir villages have fertile alluvial soil but damage by *reh* is prevalent. In Bangar the soil is not good; it is either sandy or is cut up by ravines and water-courses. Water is near the surface in this circle and a hole 12 or 13 feet will find a spring in most places, but irrigation for the most part is dependent on *kachcha* wells.
- (2) *Bangar* is almost uniformly a fine level tract. Water is found at from 20 to 25 feet beneath the surface.
- (3) *Dhauri-Saitab*. It is a well defined strip of country immediately below the hills in the drainage line of the rainfalls thrown down the slopes of the hills in Ballabgarh. In tehsil Delhi it lies round the low ground of the Najaligarh *jhil* and the area of most of the villages is more or less submerged by the floods which come down from the west or north-west.
- (4) *Zerkolie circle* is the suballuvial strip of country which lies on the slopes of the hills.
- (5) *Khandrat circle* lies in the ruins of old suburbs or old sites of the city of Delhi. The soil is very productive and irrigation is good.
- (6) *Kolie circle* consists of villages lying high up on the hills. The soil is generally very dry.

The Sunipat tehsil is divided into two assessment circles, Khadir and Bangar.

The Khadir lies along the river Jamna. The soil is sandy but very fertile.

The Bangar lies to the west of the old bed of the river. It has good *Rasli* (loam soil).

1. The average depth of permanent wells—It is—

In tehsils Delhi and Ballabgarh—

	Feet.
Chak Kladia . . .	12
" Bangar . . .	20 to 25
" Dhauri . . .	12
" Zerkolie . . .	16
" Khandrat . . .	25 to 30
" Kohi . . .	30 to 40

(In Ballabgarh irrigation by wells is almost unknown in the chak but in tehsil Delhi there is some slight irrigation.)

In tehsil Sunipat—

	Feet.
Chak Bangar . . .	25 to 30
" Khadir . . .	25 to 18

2. The nature of the supply whether from springs, or from percolation—Generally it is a spring but in some places in chaks Khadir and Dhauri it is also percolation.

In the Khandrat circles water is often slightly brackish but with a light *rasli* soil it is considered very fertilizing.

Tobacco, chillies and other vegetables are generally irrigated from these brackish wells and the produce is generally good.

The wells in the Kolie circle generally fail in the years of drought but the wells in the Bangar, the Khandrat and the Zerkolie circles though giving a deficient supply in years of drought do not fail altogether. The wells in the Khadir and Dhauri circles have got sufficient water and the supply from them is generally good. Percolation wells, however, give a deficient supply in years of drought.

3. The average cost of construction—

Permanent wells are of three kinds in the Delhi District.

- (1) Ordinary masonry wells made of brick or stone and mortar.
- (2) The dry masonry wells (*kurand-kao-kan*). This is found chiefly in the villages near the hills where the vicinity of the rock renders the use of rough half hewn stone very cheap, but there are not very many places where this kind of construction really answers.
- (3) The wooden well or the well of which the sides are made of carved black pieces of wood in length varying from 9 inches to 2 feet. The wooden structure is called a *kothi*. Wells of this kind are found specially in certain villages of Chak Khadir.

In Chak Kolie a well costs not less than Rs. 1,000. In Chak Zerkolie the cost is Rs. 400. In Chak Khandrat Rs. 500, in Chak Bangar Rs. 300 and in Khadir and Dhauri about Rs. 200.

4. The average duration of a well—

That masonry wells often last hundreds of years.

The wooden wells in favourable soil and not too deep sink, but for many years, sometimes a full generation, generally not less than 30 years.

5. The manner in which water is raised—

A rope and bucket called *charra* is generally used in the southern and the central part of the district.

Persian wheel or *Harai* is also common in the north of the Sunipat tehsil.

6. The average area attached to and commanded by a well—

In Chak Kolie it is about 4 acres, but in other chaks it is from 10 to 20 acres.

7. The average area irrigated in any one year—

Half of the total area attached to a well is generally irrigated in a year. Eleven acres on the average is the area watered in a day from an average masonry well.

8. The increase in the value of the produce of land irrigated from a well—

The land irrigated from a well generally gives two crops in a year. In the case of sugarcane, however, there is no second crop in rabi. In the Khandrat circles they sometimes take several vegetable crops in a year.

Only superior things like wheat, barley and sarson in rabi, and sugarcane and cotton in kharif and also vegetables and spices are grown on well irrigated lands. Chari and bajra also are grown on chahi lands.

The yield from well irrigated land is about double of the yield of similar barani land.

In Chaks Kolie, Khandrat and Bangar, there is comparatively very little cultivation in barani lands in the years of drought and all irrigation wells are then worked to their full power.

9. *Rates of rent and revenue.*—The immense majority of the tenants with rights of occupancy and a large number of tenants-at-will also pay their rent at revenue rates. The number of occupancy tenants, who pay rent in kind, is small. The commonest form of rent paid by tenants-at-will, when it is something more than mere revenue, is a lump sum for the holding and is called *chakota*. Another mode is by revenue rates *plus malikana* (landlord's fees) at so much per cent. on the revenue or by a lump sum per bigha which then without reference to percentages includes the revenue. In many places a rupee a *kachcha* bigha or about Rs. 5 per acre. Generally a holding comprising both barani and irrigated land is given to a tenant on these rents. But irrigated land alone is given on about Rs. 5 per acre.

The rates of land revenue per chahi (well irrigated) and barani lands are—

Lala
Bishamber
Diyat.

*Tala
Bishamber
Diyal.*

In tehsils Delhi and Ballabgarh—

	Chabi rate.	Barani rate.
Chak Khadir-Bangar	3 4	0 14 0.
" Bangar	3 0	0 12 0
" Daihri	3 0	0 12 0
" Zerkolie	2 12	0 12 0
" Kolie	2 4	0 10 0
" Khandrat	4 0	1 0 0

In tehsil Sonipat—

	Irrigated.	Barani.
Bangar Chak 3 0 from 0 12 0 to 2 15		
Khadir " 2 12 " 0 12 0 " 1 6		

A uniform rate was adopted for well irrigated lands in a village and lands irrigated from *kachcha* wells were taken as irrigated with regard to the irrigating power of this description of well.

Land revenue is generally paid at irrigated rates for all the land attached to a well as irrigated land; no remissions being given for land, which is temporarily not irrigated.

10. The Delhi District has got a large number of masonry wells and about 15 per cent. of its cultivated area may be taken as protected by wells. Excepting the Kolie Circle in Ballabgarh and Delhi tehsils where water is found at a great depth and where well irrigation is not common in all other parts of the district irrigation from wells is very common.

In the Daihri Sailah Circles of Ballabgarh, however, wells are little used as there is little need for them. In Zerkolie Circle of Ballabgarh also irrigation is scanty, but it is very common and good in all the Khadir-Bangar and Khandrat Circles. There are numerous wells in the Khadir and Bangar of Sonipat and in the Khandrat Circles of Delhi and Ballabgarh. Old wells are common in the Khandrat Circle, and they can be put into working order at a little expense.

Generally speaking there is no difficulty in the selection of a site for well construction. The agriculturists themselves know where they will obtain a good supply of water, and there is a class of experts in the west which is called *sungha* (smeller) who smells the earth and gives his opinion as to the possible depth and the nature of supply. Opinion of these experts is almost always sought in making the selection of a site.

But the real difficulty which stands in the way of many is the want of money which is required to sink a well.

The State or the District Board has not given any help in the shape of boring or lending boring instruments. Such a help is not very necessary, I think, as the agriculturists themselves and the experts called *sunghas* have no difficulty in finding out a suitable site.

The State has from time to time advanced takavi loans, and in my opinion this is the best help that the State can give. The takavi loans should be given as frequently as possible, and generally on liberal terms. The period for repayment should be fixed long enough to enable the borrower to pay it easily out of his savings from the enhanced income due to well irrigation.

11. I am not in favour of the construction by Government of wells in land belonging to private persons. The people themselves appreciate irrigation and make masonry and *kachcha* wells when required and when funds allow. The State, with its limited resources, cannot be expected to make a very large number of wells and in the land of every person who applies for that. It will cause heart-burning to those who are refused. The officers of Government will also find it very difficult to manage irrigation from Government wells.

12. *Kachcha wells*.—Generally it is a well dug in the earth with its sides fenced round with the brush wood of various kinds and thus forming a rude support to the crumbling soil. These wells are very cheap and in many places last one, two or three years. The depth to which they are sunk is of course small, the deepest being about 20 feet. Another kind of *kachcha* well is what is called a *jhalar*. It is made on the sides of river streams or jhils (lakes), and water is drawn by a variety of Persian wheels with larger pots.

Water from ordinary *kachcha* wells is drawn by a hand lever called *Dhokli*.

Kachcha wells are common in the Khadir of Sonipat and in the Khadir-Bangar of other tehsils and some are also made in the Bangar Circles of all the tehsils.

A *kachcha* well costs from Rs. 10 to 15.

In years of drought every one is willing to sink as many *kachcha* wells as he can and takavi loans for *kachcha* wells may liberally be given in those years. Each such well protects about one acre of land and an agriculturist who has got two or three such wells can grow an average quantity of crop even in years of scarcity and drought.

(20) MALIK TALIB MEHDI KHAN, Extra Assistant Commissioner, Rohilk District.

A.—GENERAL.

*Malik Talib
Mehdi
Khan.*

1. My answers refer to Rohilk District. I joined it on the 10th July 1898 and had on several occasions inspected the villages of Jhajjar tahsil in connection with suspension scheme or takavi and was in charge of famine operations under the Civil Department in the same tahsil from September 1899 to December 1900. In May 1901, I was appointed

Revenue Assistant and had every facility of going about and visiting other parts of the district. Under these favourable circumstances I studied the irrigation problem closely, which was over out of my mind since I realized that the district was always insecure and susceptible to periodical famines. Moreover I am a big landowner myself and had a fairly vast agricultural experience before I joined the district.

YEAR.	Janu.	July.	August.	Septem-ber.	Octo-ber.	Novem-ber.	Decem-ber.	Janu-ary.	Febru-ary.	March.	April.	May.
1891-92	55	4.08	9.24	3.62	84	23	...	1.03	52	...	...	1.02
1892-93	77	6.31	12.79	6.09	...	...	1.35	1.50	1.86	1.48	16	1.39
1893-94	3.38	9.75	4.37	10.67	...	03	...	2.43	63	44	...	21
1894-95	2.61	7.44	6.14	9.40	...	93	2.80	3.33	56	10	41	...
1895-96	3.95	4.87	3.38	20	...	...	39	60	1.44	25	...	89
1896-97	1.79	4.91	2.91	49	...	11	12	...	...	25	60	41
1897-98	1.73	6.08	7.68	2.65	...	...	...	1.61	...	...	34	1.85
1898-99	3.00	6.23	1.91	1.60	...	...	0.79	0.30	...	...	0.29	0.12
1899-1900	4.99	3.25	1.45	0.73	0.15	...	...	0.66	...	0.12	0.91	0.38
1900-1901	1.18	4.85	6.09	16.40	0.23	0.70	1.62	1.44	0.88	0.52	...	0.70
TOTAL	24.85	57.70	50.86	51.56	1.22	1.89	7.07	11.19	7.60	3.16	2.61	6.97
Average	2.48	6.77	5.08	5.15	12	20	71	1.12	75	31	26	70

(1) No.

(2) The great famine of 1899-1900 took away cattle from this district by thousands and there is not any large supply of them at this moment, but it is only temporary and a torn to better of the harvests for next two or three years, will bring the stock of bullocks at least to its requisite level. The live stock is a great source of wealth in the district and the zemindar is alive to his interests in that line.

(3) The supply of manure is not equal to demand just at present owing to loss of cattle referred to above, but there is no apprehension about it as the present state of affairs will soon pass away. Moreover the zemindar of this district (excluding those Malis who reside near towns) is not in the habit of growing more than one crop ordinarily on the same field during the year, and a thin layer of manure answers his purpose.

(4) The soil is generally suitable except in a limited area *near the canal and the bed of the Sahibi Nali (Jhajjar tahsil) or Jhill (Sampla tahsil) where there are cracks in the land.*

(5) The Western Jamna Canal is the chief source of irrigation, and the supply of water is always insufficient during periods of scarcity. There is no complaint of its too late commencement or too early cessation as the flow is generally regular though feeble.

(6) Successive adverse seasons have reduced the zemindar's resources and there is a lack of capital for the initial expenditure which is heavy for sinking a masonry well as the water is generally deep. Compared with it the cost of taking canal water to his field is simply nothing as he has to make a small water-course from a minor which generally waters a large number of fields and the expense is shared by all owners thereof. Irrigation from wells is more expensive, for one well requires four bullocks at least and four men, two or three buckets and ropes for one crop, and the heaviest of all expenses, fodder for bullocks. This and the unceasing labour required for working it prohibit the extension of irrigation by this means, particularly in those tracts where the water lies deep beneath the surface.

(7) No; the tenant never improves the land he holds by extending irrigation at his own cost and the land has been assessed on dry rates and the landowner has to pay nothing extra for the crop he raises by means of irrigation from a well, sunk after the settlement. He has no regard for the canal revenue or Chahi rate, as it is the canal and wells alone which keep the soil from his door during the periods of scarcity, which unfortunately have become a matter of every day occurrence in this district.

(8) No.

(9) (a) The chief obstacle to extension of well irrigation is uncertainty as to the quality of the water—an uncertainty which exists in the whole district except Dehr or Dabar land and in those villages which have received an ample supply of canal water for several years. There are tracts in the Jhajjar and Sampla tahsils where the water is known to be good and in them fresh wells are dug whenever funds allow. Further the water which was sweet in a period of good rainfall becomes brackish after several years' scarcity and many wells (each of which cost no less than Rs. 1,000) have fallen into disuse. This has driven the people to sink drink wells round their tanks in spite of the unwholesomeness of the water.

(b) In tahsils Rohtak, Gohana and the remaining portions of Sampla, there is a strong desire and hope of the extension of canal irrigation and this is also militating against the spread of well irrigation to a large extent.

4. No expense is incurred on construction of private canals in this district, and consequently there are no exemptions. Protective pattas were given during the last settlement for sinking wells. The land was assessed at dry rates for 20 years commencing from the date of irrigation for the first time. Very little advantage was taken of it, and the measure was never popular with the zemindars nor I think it will ever be. There is no need for making any alteration in the system. Tenants-at-will are not allowed to make any permanent improvement on the land. They are allowed in some places to sink temporary wells and hold land rent-free for one year, after which the wells become the property of the landlord, or the tenant pays rent if he holds the land for another period.

5 No; a tendency is, however, evinced since the famine of 1899-1900 which brought more vividly before the mind of the people the advantages of the artificial means of irrigation. I will speak of wells only under this head, as no loans are required for extending canal irrigation, as that is mostly done by the State. The reasons of reluctance on the part of people to take takavi are:—

(a) a zemindar is generally a fatalist and he soon forgets the lessons of bad years. This is, however, being remedied naturally.

(b) The Government is forced to take the place of a *bania* in this instance, but it is not so easily accessible and prompt as he is, an application should be received and attended to promptly. At present there are instances in which necessary enquiry was not completed within six months after the application was tendered; during which period, the applicant had to go to tahsil a dozen times and his desire which sprang up at a particular moment is satiated by the trouble and expenses, part of which is due to blackmail. The only precaution to be taken is to see that the society is good; when this is done there ought to be put no obstacle in his way.

(c) The tahsildar is the chief instrument of securing this grant for him, and in not a few cases he wishes to avoid the trouble of going about for inspection of the progress of these works, and desires to have his tahsil free from Government debts.

(d) His multifarious duties do not allow him sufficient time to take a personal part in the enquiry, and it is left entirely into the hands of tahsil Wasil Baqi Nawis, who not seldom through indifference or other ulterior motives prolongs the work.

(e) In the same way the *sadr* Wasil Baqi Nawis sends back the file to tahsil for a titular mistake and another month passes for rectifying it, which could have been avoided in many cases, if he sends for the tahsil Wasil Baqi Nawis and gets the error corrected in his presence.

(f) In my opinion the work should be made over to the Revenue Assistant of the district, and he should be made responsible for completing the enquiry and pay the money or submit the file to the Collector for payment only.

(g) There ought to be one period for receiving the applications, and I think October is the best time. The Revenue Assistant may inspect the places in the same month, when he goes out for Girdawari inspection, if he has got time, otherwise he may put it off till November or December and complete the file by such date that the Collector is able to give the money in the first fortnight of January.

(h) The advantages of this scheme will be less delay and payment of money to zemindar at a time when he and his bullocks have no occupation in the field and can finish this work till harvesting time of rabi crops or at least make a fair progress till then.

(i) The Revenue Assistant may be given authority to get the tahsildar's help where it is absolutely necessary.

(j) The present rate of interest is not at all very high, but it stands in the way of borrowing money by a zemindar owing to his broken condition caused by successive bad years. To give an impetus to the extension of well irrigation, I

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think a reduction in it is necessary generally. If not, reduced rate may be introduced in those parts where well irrigation is in a backward state, and kept in force till sufficient advance has been made and a desire has taken root in the mind of people.

(2) No.

(3) Na.

(4) Yes; the remission of that sum only which has been actually spent before the failure is perceived and remaining money to be refunded or converted to a new loan for another well at the option of the borrower.

(5) No; the burden of interest becomes unbearable.

(6) Na; in many cases the zemindar may not be able to raise his share of the outlay and the Government money wasted.

6. No; occupiers of unirrigated land only migrate to irrigated parts, and that to a small extent in time of scarcity. They return when the scarcity is over. There is a great demand for canal irrigation and the reasons are apparent, the work is simple and easy. Recent events have however proved that the canal oven (at least Western Jamun Canal) is not a safeguard against famine, and notably so when the Government is extending the water towards the tail and benefiting everybody alike. I have found that same irrigation wells have been recently added in Gohana taluk, where the people never took to them. The majority is still against them, but necessity is obliging them to give up the tradition.

B.—Canals of continuous flow.

7. (1) The practice of raising two crops on the same land is not followed in this district.

(2) Irrigation increases the value of the produce of land from two to three times by substitution of sugarcane, cotton and wheat for other inferior crops such as barley, gram, jawar, bajra and gawar. Indigo seed used to be sown in days gone by, but low prices have checked its cultivation for the last two or three years.

(3) (a) No increase,

(b) twice as much,

(c) three to four times.

8. It is difficult to give this increase in figures, as every crop has got a different yield and some do not grow at all on unirrigated land. Roughly speaking it is—

(1) twice as much,

(2) four times.

9.

(1) Nothing; for there is no private canal in this district.

(2) Generally the cultivator pays Rs. 10 per acre to the owner in the form of rent, which is nearly double the amount paid for dry land. In some places it is Rs. 7-8-0 and in a few Rs. 12 and rarely Rs. 15.

(3) Different rates for different crops. The principal crops sown in this district and the rate per acre are:—

	Water rate.				Owner's rate.				Cesses.				Total.			
	Rs.	A.	P.		Rs.	A.	P.		Rs.	A.	P.		Rs.	A.	P.	
Sugar cane	6	10	0		2	13	0		0	7	11		8	14	11	
Cotton, indigo seed, and all rabi crop with the exception of gram and masur	2	8	0		1	4	0		0	3	9		3	15	0	

The owner charges it on the whole irrigable area, but the Government charges only that area which has been actually irrigated during the year, and if two crops have been raised, then on both of them.

10. No expenditure is incurred in bringing the water to the field; the usual operation of a water-course is done by the zemindars whose land will be profited by it and no

paid labour is applied, but if there is any necessity for it e.g., when the zemindars are busy in their fields, the rate at which a water-course is dug, is 3 pies per cubit onbit. The land in this district is uniformly flat and no capital is required for preparing it. The ordinary levelling or embankment round it is made by the zemindar himself. The landlord and occupancy tenant bear the cost. The occupancy tenant is practically a landlord in this respect.

11. Twenty years ago the area under canal was limited, rain abundant, and there used to be too profuse and too frequent irrigation. The water accumulated in the low levels round the villages and in the fields and the result was salt efflorescence. The land deteriorated and bore no crop for some harvests. A white powder spread over the surface and made it very soft for about six inches deep. It was due to stagnation of water and constant moisture. The villages along the canal were chief sufferers and those also which were situated on a much lower level than the water surface. On the other hand, it affected the health of people; they had a tendency towards becoming sickly, sluggish and less strongly built than their brethren of dry tracts. There was another complaint namely the barrenness of females. I cannot say whether the defect lay in males or females, but it was attributed to the latter. The remedy resorted to by the people in this district was sowing Kikar trees on the area affected by *Reh*. They say that rain water reaching the land after washing these trees takes the evil away after 10 or 12 years. The trees are removed and the land becomes as good as it was before. The experiment has been successfully tried in this district. Another cure was described to me, but has not been put to test in this district. Prepare a piece of land affected by *Shor* in such a way that it slopes towards the centre and dig a ditch dividing it into two parts, fill it with water, let the water dry up till it remains in the ditch alone, add as many *Al* trees as the land can hold, let them rot. Take out the rubbish and soft earth collected there and bury it somewhere. Repeat this three or four times and then level the land which is quite free from the evil. Both these remedies will be efficacious only in a limited area in my opinion, for I cannot conceive how the people can afford to turn their whole land into a jungle of Kikar trees. The best remedy is drainage, it has been very successfully practised here and has been the cause of saving the affected villages. The cultivated land has all been cleared of *reh* and all other evils are dwindling away. It still exists on uncultivated land but that will also disappear after some years of good rainfall, I think.

C.—Canals of intermittent flow.

12. None in this district.

13. See question 7.

14. It is very difficult to ascertain the loss resulting from too late commencement or too early cessation of the supply of water, as it chiefly depends on the duration of period and the kind of crop, but roughly it amounts to from one-third to one-half.

15. Not in this district.

16. See question 8.

17. See question 9. No private canals in the district.

18. See question 10.

19. See question 11.

20. The owners of the land getting benefit from a water-course, do this ordinarily with their own hands and no estimate of cost can be made. The system is working fairly well and no legislation is required.

21. No.

22. There is not much room for it, as the Western Jamuna Canal has been extended as far as possible.

D.—Tanks.

23—33. Every village has got a number of tanks which are used only as reservoirs of water for cattle and men (in some cases), and there being no irrigation from them I think no answers are needed under this head.

E.—Wells.

34. The district may be divided into five main tracts.

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West of Rohtak Tahsil.	Dehri.	Nahr.	Roht.	Bhär.
(1) 120 feet . . .	(1) 18—30 feet .	(1) 25—30 feet .	(1) 40—60 feet .	(1) 40—60 feet.
(2) From percolation supply does not fall perceptibly, becomes saline, after a series of years of scarcity.	(2) From percolation supply does not fall nor becomes saline.	(2) As in Dehri .	(2) As in west of Rohtak.	(2) As in west of Rohtak.
(3) Rs. 2,000 . . .	(3) Rs. 250 . . .	(3) Rs. 350 . . .	(3) Rs. 800—1,000 .	(3) Rs. 600—800.
(4) 500 years . . .	(4) 200 years . .	(4) 150 years . . .	(4) 300 or 400 years .	(4) 300 years.
(5) Bucket and rope .	(5) Bucket and rope .	(5) Bucket and rope .	(5) Bucket and rope .	(5) Bucket and rope.
(6) About 3 acres . .	(6) 12 acres . . .	(6) 12 acres . . .	(6) 10—12 acres . .	(6) 10 to 12 acres.
(7) „ 4 „ . . .	(7) 10 „ . . .	(7) 9 „ . . .	(7) 8—10 „ . . .	(7) 8 to 10 „

This estimate refers to a well which is worked by one bucket and rope. There are many wells in Dehri, Rohtli, and Bhär which have got two buckets and ropes. They command, and water an area twice as much as a single well, with an extra cost of Rs. 200 for sinking them.

35 (1) Ordinarily one crop is raised.

(2) The value of the produce becomes double.

(3) (a) The yield is from equal to one and-a-half of that from Barani land.

(b) Double or treble.

(c) Four times.

36. Roughly speaking the increase is—

(1) Barley 15 maunds, wheat 10 maunds.

(2) Pure Barani land produces nothing in a year of drought.

37. (1) From Rs. 5 to 8.

(2) From Rs. 2 to 3.

These rates are paid on the total area attached and commanded by the well.

38. (1) Water is found everywhere, but in many places it is brackish or becomes so, as noted in paragraph 1 (9). On the other hand the depth of the wells sunk in the western part of Rohtak tahsil is above 100 feet and the heavy cost of working them and comparatively small profit are a stumbling block in the way of irrigation by this means. The difficulty is confined to a small area fortunately and is not serious.

(2) None with the exception of cost in the case of deep wells.

No assistance has ever been given by Government or Local Bodies, but I think it will be of great value if trial

boringe are undertaken by either. This can be worked by two methods; first by giving people money for trial borings gratis and secondly the Government doing the work itself. There is a serious objection to the former method, although it is simple and cheaper, namely, that the money will not be fully used for the purpose for which it was given, but applied on other pressing needs of the hour. There is no doubt as to its utility.

39. No, and for the following reasons:—

(1) The people may not be willing in giving the land for the purpose in which case the cumbersome machinery of Land Acquisition Act will have to be set in motion.

(2) The initial costs, cost of annual repairs, of an establishment to take care of them, prohibit the venture.

(3) The principle followed by Government on canals has been to levy water revenue for area actually irrigated and the same will be enforced probably on wells also. Thus there would be no income in years of plentiful rain.

40. Yes, each one of them waters 5 or 6 acres and the cost of sinking it is Rs. 50. They last for two or three years and can support a family of 8 or 10 souls during a famine. They are no doubt a protection against famines. They have been found very useful in those parts where the water is brackish, as they are not sunk below the point where the water begins to be bad. The best way to encourage their construction is to give the money without interest. The sum will always be small (about Rs. 50) repayable within two or three years and the interest will not amount to much.

(21) MR. A. B. PHELAN, M.I.C.E., Superintending Engineer, Bari Doab Circle.

A.—General.

1. My answers refer to the Upper Bari Doab, and Sattlej Khadir Tracts, in the Gurdaspur, Amritsar, Lahore and Montgomery districts. I have been in charge of canals in these districts in the capacity of Assistant, Executive and Superintending Engineer, commencing from the year 1868.

Rainfall.

2. The following is a statement of the average monthly rainfall in the four districts irrigated by the Canals in this Circle. The statistics of rainfall in the case of the three districts irrigated by the Bari Doab canal are shown for 21 years and in case of Lahore and Montgomery districts watered by the inundation canals they are given for seven years as the records for the latter are only kept up from 1st April 1893.

Statement showing the monthly average mean rainfall for the Gurdaspur, Amritsar and Lahore districts of the Bari Doab canal, and Montgomery and Lahore districts of the Upper Sattlej inundation canals.

Months.	BARI DOAB CANAL.			INUNDATION CANALS.	
	Gurdaspur, average on 21 years.	Amritsar, average on 21 years.	Lahore, average on 21 years.	Montgomery, average on 7 years.	Lahore, average on 7 years.
January .	2.463	1.550	1.189	0.928	1.293
February .	1.785	1.225	1.050	0.690	1.190
March .	1.095	0.747	0.612	0.070	0.870
April .	0.508	0.320	0.269	0.130	0.157
May .	0.706	0.587	0.572	0.230	0.353
June .	3.510	2.658	1.940	1.138	2.249
July .	9.527	6.419	5.610	1.185	3.550
August .	9.673	5.916	4.345	1.655	2.784
September .	3.228	2.012	1.918	0.493	0.788
October .	0.190	0.206	0.190	0.003	0.003
November .	0.057	0.036	0.053	0.011	0.009
December .	0.946	0.631	0.459	0.136	0.258

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C.E.*

Mr. A. D.
Phelan,
M. Inst.
C.E.

3. There is no obstacle to the extension of irrigation arising from—

- (1) Sparsity of population.
- (2) Insufficiency of cattle suited to the cultivation of irrigated lands, excepting possibly in the western parts of Montgomery.
- (3) Manure is sufficient for the crops raised and is seldom applied, except for the cultivation of first class kharif crops, and garden produce.
- (4) The soil is very suitable. There are a few sandy parts, but this is the exception.
- (5) The Bari Doab canal is a perennial one, taking out of the Ravi river. The supply is short and below demand during the months of October, November, December, January, February, and first-half of March. On the inundation canals the irrigation is affected seriously owing to the late rising of the rivers and the early dropping of the supplies in the same.
- (6) This has not made itself felt as far as I am aware.
- (7) When changes in the assessments occur I think there is a hanging bag for a time until the effect is appreciated. The supplies available are, however, greedily availed of, so that the fears of future enhanced assessments are not entertained or fail to act as deterrents.
- (8) I cannot reply to this clause.
- (9) Other reasons may be due to the action of Government, who proceed slowly and tentatively in sanctioning possible developments. Also to the fact that irrigation practice and science cannot be said to have been fully developed. The perennial canals in my charge were made too small to begin with, and according as they are remodelled and enlarged developments and extensions speedily take effect and are noticeable by increases in revenue and advances in the gross areas irrigated. A serious obstacle to the extension of irrigation is, I think, traceable to early want of experience, in that the water-courses were not laid out on predetermined plans and outlets were granted on incorrect data. A great want is felt to be some summary legislation which will permit the canal officers to remodel and realign village water-courses and to construct others, although injury to individual fields may be experienced. This difficulty is great and the obstacles tend to increase, in that the value of land has risen greatly on the irrigated tracts on the perennials. The increase is about 4 or 5 times the original value. At the same time I do not think it to be understood that the owners of fields and lands, which are required to be taken up should not be compensated for damage and loss, but that the procedure is too cumbersome in practice and delays occur. Also to the fact that the perennial canals also gain nothing from floods and floods in the rivers which exceed their limiting full supplies. Were these canals made capable of taking off extraordinary supplies during the rains, areas could be irrigated preparatory for rabi (winter) sowings, such a practice prevails on the inundation canals. Larger capacity is also necessary to admit of the kharif (autumn) crop being fully sown on the rivers fall so that the rabi (spring) crop may be started early in October and the demand rendered as free of liabilities for maturing the previous autumn crop as possible. It must be recollected that the summer supplies in the Punjab rivers always exceed the capacities of perennial canals, but it is not so for the winter volume. The short supplies available restrict the areas irrigable of cereals and fodder crops, so that to increase these areas resources must be had to the supply available during the rains.

5. Though I do not propose to reply to all of these points, yet it is generally thought amongst irrigation officers that "takavi" loans made under the Land Improvement Act should be fully available to the cultivators for the extension of canal irrigation in the way of constructing the watercourses and their attendant works. The expenditure on these works could be entirely supervised by the Irrigation Department, while recovery of advances may be made at leisure or after the people have reaped a crop or two. About this I entertain no difficulty whatever.

Such a procedure has in fact been made applicable to the irrigation of new colonies in the Bari Doab located at Vahn, Gundlan and elsewhere. The said advances were made from funds at the disposal of the Irrigation Department. Recovery was in all cases practicable. Interest was not charged to the persons interested. No doubt similar arrangements are possible in the case of developments in proprietary villages, and such an arrangement would be preferable to the cultivators starting in debt to the Local bankers (banias).

I may reply therefore, provided the work be retained in the hands of the canal officers—

- (1) No interest need be charged.
- (2) It would be remitted.
- (3) As above.
- (4) Such a contingency would be impossible.
- (5) All could be collected within the period for reaping of the fifth crop.
- (6) Grants-in-aid are unnecessary.

6. I have heard that this occurred to some extent on the banks of the Ravi, because the Chenab Canal colonies attracted the tenants. The people of the districts over which I have control are simply ravenous to obtain the means of irrigation, even where the areas are fully irrigated the demand continues for crops of the better class. I would like to give the following instance, which I do not think is an extraordinary one by any means:—

"Sirdar Tara Singh of Uman, who is a very fine soldier, and is Aide-de-Camp to His Excellency the Viceroy, obtained a grant of land in the crown waste called Itakh Dhalla, Chaudhian tahsil, Lahore district, some five years ago. The grant was for 200 acres of uncultivated waste, the land being of good quality throughout. He was led to expect canal water sufficient for the annual irrigation of 40 per centum of his estate. Within two years of his starting farming on his grant, he applied to me for a better supply of water, with this view he asked to have the orifice of his outlet enlarged. I made an investigation through the Executive Engineer, who in due course reported that the Sirdar held 231 acres of land, that he had been assessed for water-rates on 210 acres during the previous year. I pointed out to the Sirdar the apparent inconsistency of his application seeing he could irrigate the whole of his grant, and I enquired from him what was his object, to which he replied that he was desirous to cover his estate with sugarcane and rice crops. I may therefore predicate that the demand for water for the purpose of irrigation in the dryer tracts of the Bari Doab is practically insatiable."

During my term of office as Superintending Engineer of this Circle, there is not or was not, an unirrigated lot or tract anywhere near a canal or possibly within command of the Bari Doab Canal system for which I did not receive and entertain applications for canal water. A great number of these have received attention and some more are still under consideration, but the evident object of the people is to have the arterial system developed throughout the whole commanded Doab.

During the present season certain cultivators of the Batla tahsil of the Gurdaspur district, whose lands are very favourably irrigated during the autumn crop, are keenly agitating to obtain more liberal supplies during the winter season for the spring crop, indicating a desire to extend the areas of land irrigated.

It is possibly thought that provided a tract receives sufficient or abundant rainfall that canal irrigation is less necessary or called for therein, whereas it is known in practice to the contrary, that the best irrigated tracts are those where rainfall is greatest, the difference being in this case that higher class staples are cultivated. The water-rates in the autumn crop decrease in average amounts from the head of the canal to the tail. Thus the average water-rates in the Gurdaspur district throughout the autumn crop exceed Rs. 8 per acre, while that for the 3rd Division, Bari Doab Canal, consisting wholly of the Amritsar and Lahore districts, averages Rs. 3-5-0. On the other hand the kharif rainfall in the Gurdaspur district averages 39 inches, in the Amritsar district 19-3 inches, and in the Lahore district 15-3 inches. The same differences in the average water-rates of the spring crop do not obtain, because they are more uniform for that crop. Having regard to this point although it is possibly beyond the immediate scope of my experience, I would note that probably the best irrigated tract in the Punjab is the Kangra district, on which the rainfall is about the heaviest.

B.—Canals of continuous flow.

7. I doubt if we have any reliable statistics from which we can reply satisfactorily to these questions, because the staples grown are so numerous and fluctuations in crops and their values are so wide. However, we know for the Lahore and Amritsar districts that the Settlement Officers have assessed land revenue on canal irrigated land at one and a half times the dry rates. This is really a very low valuation. In many parts of my districts the land was lying waste before the canal was made, giving a very moderate amount of pasture to cattle and producing a few stunted trees, where now magnificent crops of the highest value are being raised. Two years ago I had occasion to notice a fact which may be useful as an illustration. It was a year of drought, but very fine crops and large areas were being cropped on the Bari Doab Canal. There are now colonies at the extreme end of the canal in the Lahore district, but bordering on the Montgomery district, a very dry one, in which the area irrigated is about 60 per centum of the gross cultivable. To some of these new villages expert agriculturists had emigrated from the more densely populated tracts of the Doab, and had planted sugarcane. This they sold as fodder to the Ravi riverain villagers for about Rs. 120 an acre. The water-rate for this crop on the Bari Doab Canal is Rs. 7-1-0 an acre and the enhanced land revenue is 6 annas an acre on all irrigated land payable once a year, and not per crop, in the colonies in question.

I am informed by credible witnesses that the annual produce of an acre of canal irrigated land in the Lahore district is valued at Rs. 120 an acre, in this case it is assumed that the land is double-cropped. It is usual to double-crop land which had previously been planted in the summer with cotton, maize, and rice. The succeeding crop is ordinarily one of wheat.

The increased value of the produce consequent on the opening of the Bari Doab Canal may in some measure be tested by comparing the compensation paid for land while the canal was under construction and in these days, but omitting the specialities such as land bordering on cities and towns. The ordinary price paid for cultivable land was on the former occasion about Rs. 50 an acre, whereas recently compensation has been assessed by the Deputy Commissioner on land required for new distributaries as follows:—

	Rs.
<i>Lahore District.</i> —Canal and well irrigated 125 an acre.	
Rain-cropped	87 "
Uncultivated	40 "
<i>Amritsar District.</i> —	
Canal and well irrigated	
Land	240 an acre.
Rain-cropped	120 "

I would therefore compare the values of the produce of unirrigated and well irrigated land at from one to one-and-a-half, to two, as a low valuation, whereas I have no doubt on the whole the value has increased by four or five times. I would recollect that the produce of rain-cropped land varies enormously in value, from a minute quantity upwards, whereas on canal-irrigated land a good crop is the rule, an inferior crop the exception. The value of land near cities has increased enormously, and is now worth Rs. 1,000 an acre.

8. The estimated value of produce on canal irrigated lands varies with the market, of which some instances are as follows:—

	Rs.
For the year 1891-92, ample rainfall	30 an acre.
" " " 1896-97, scanty rainfall	30-5 "
" " " 1898-1900, drought	35 "

In a year of drought large tracts of the country depending on rainfall will produce nothing, while on the other hand the cultivators are liable not only to lose the seed they may have sown, but all their labour is in vain. We have also to differentiate by districts, for instance in Gurdaspur the cultivators in ordinary years secure a crop on the rain only, whereas in the Lahore district there may be often total failure.

9. The average rates of assessments in each harvest on the Bari Doab Canal payable at occupier's rates, in which are included owner's rates are as follows:—

	Rs.
Kharif or autumn crop	4-0 an acre.
Rabi or spring crop	3-1 "
For whole year	3-5 "

In this case water-rates are paid on the area actually irrigated and are assessed twice a year.

As enhanced land-revenue, a wet rate, is also assessed at from 4 to 6 annas an acre. This rate is assessed at time of settlement on fields which have been irrigated or assessed for water-rate during the preceding four years, and is therefore levied on the area ordinarily irrigated and that but once a year. The cultivator or land-holder responsible to pay the land revenue is also responsible for the payment of this rate which is locally known as "Nuhri Parta."

10. Very little is known about this on the Bari Doab Canal, and anything which can be said will be, but an approximation. The cultivators generally including tenants, dig the water-courses, and a limit in cost will be some 8 annas to one rupee per acre commanded. Little or no cash expenditure is incurred for excavation for the cost of land required, but bridges and other masonry works have to be paid for. They do not obtain on every water-course, the charges when levied are paid up by the individuals, who have a claim to the land, such as land-owners and permanent tenants. The matter is of little or no importance, as it forms but a small factor in the benefits derived. The larger water-courses are sometimes made under the supervision of Canal Officers, the people interested subscribing sums proportionate to arrears commanded, in advance. The cost of such water-courses is about 8 annas to one rupee, a chain of 100 feet exclusive of land seldom or never acquired and of masonry works of which there are few. The Canal Department in these cases waives all subsidiary charges such as percentages for establishment, tools, and plant.

11. The Ravi water contains silt and salts which are most useful for improving the soil. The Settlement Officer of Gurdaspur declared that the poor loams of that district were reclaimed and improved by reason of canal irrigation which in this way differs from well-irrigation. The latter in fact often destroys the land, leaving sulphate of sodium and other deleterious salts on the surface. In certain tracts, more notably the salt-zones of the Lahore district, it is possible to reclaim such lands and recover them by the use of canal water, which washes away or back into the sub-soil the salts that are inimical to cultivation, and leaves a rich deposit. Some tracts, more notably in the Amritsar district, are uncultivable or largely affected by salt effluence, but were sufficient canal water available for all such, these salt lands can be reclaimed. These tracts are more particularly noticeable along drainage lines, but they were present before the canal was made. Water-logging is noticeable in but a few places and is due to lavish rice irrigation; the possible remedy is change of crops, reduction of supply to such tracts by extensions of irrigation to others, closing the distributary channels during the spring crops.

The Bari Doab Canal and its distributaries do not, to any appreciable extent, obstruct drainage lines or the natural outfall for rain water. In a very few localities drainage lines have been cleared scientifically, but the necessity in each case is frequently the subject of dispute. For what is beneficial to one locality or village is not so to another, and similarly as regards individual owners. I do not think that the soil is at all deteriorating in spite of the immense produce removed from it and the liberal treatment as regards water supply. On this canal the area under rice cultivation exceeds that on any other perennial canal in the Punjab.

The areas booked for some years were as follows:—

	Acres.
1891-95	68,795
1895-96	61,208
1896-97	57,693
1897-98	72,476
1898-99	83,155
1899-1900	70,435

The areas so cultivated are about one-fourth of the whole autumn crop, and it is said to require an average depth of 8 feet on the surface to bring it to maturity. My

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opinion is that the area under this staple would stand a reduction, but it is a paying crop, on which Rs. 6-0-10 for water-rate per acre are charged. It is, however, a food crop and it cannot well be replaced by others.

Having regard to the draining of land I have had great experience as I carried out large drainage works in the Karnal and other districts of the Western Jumna Canal, and some on this canal. The results were every where remarkably good and equal to expectation. Swamps were reclaimed and malarious and insanitary tracts improved, while irrigation became possible in these and others. The evil is not rampant on the Bari Doab, but the Canal Authorities are alive to its necessity, and, when required, proposals for drains and the clearance of drainages are made, which are subject to the scrutiny and opinion of the district officials. Drainage works are not called for in any shape in the Lahore district, where the absence rather than the presence of water is the evil to be combated. In the Gurdaspur district the country is so uneven that water does not lie anywhere for long, nor does it produce swamps in the canal irrigated tracts. In that district the Canal Department has been concerned in draining a very extensive tract, lying in the low lands along the Bias river, opposite to Gurdaspur station, called the Kahnouwan Swamp. Some special expenditure was sanctioned, and the work carried out about five years ago towards improving an existing drain passing through this tract, with very favourable results. Land along the drain is now cultivable with ordinary crops, which before that remained a perennial swamp, and complaints have practically ceased.

The health of the people in the Bari Doab irrigated tracts is good on the whole. I have not heard of the prevalence of diseases of the spleen or gut, indicative of malaria, which were so notorious on the old Western Jumna Canal, before the remodelling of the canal and the completion of drainage clearances. I refrain from giving a more positive opinion about this point, because it appears to me to appertain to the sphere of the Sanitary Commissioner and the Medical Officers. I merely note I have not heard any complaints on the subject and I have no reason to think that there are any latent.

Having regard to silt and its uses, I would remark here that it is largely used near the larger towns, such as Amritsar, as a fertiliser and as a top-dressing for gardens and orchards. It is common to see asses laden with it, the loads being carried away from the spoil of water-course for this purpose. In this connection one must differentiate between the sand silt from which all vegetable mould has been washed out, and alluvion silt which is very fine and contains earth.

On the whole I am inclined to think that in many tracts irrigation is too concentrated, the supply too lavish, but to remedy this measures are being taken for the better diffusion of canal water and consequent irrigation. Personally I think that we are not marching with sufficient rapidity, and that extensions should be more rapidly and widely projected and completed. My Canal Officers have to undertake the duty in addition to their ordinary work. I would have been glad to see a more energetic policy and a wider programme accepted by the Local Government.

C.—Canals of intermittent flow.

12. The group of canals of intermittent flow, the subject of my text, is called the Upper Sutlej Series of Inundation Canals, which irrigate the low alluvial plain lying to the north of the Sutlej River, and within the districts of Lahore and Montgomery. Those in question are called the Katora, the Khanwah, the Upper Sohag, and the Lower Sohag-Para Inundation Canals.

(1) These canals all take out of the river Sutlej, being fed either direct from the main channel or from subsidiary creeks. The latter are rarely constant and permanent sources of supply. In no case is there a weir or dam built across the river or any work which will head up the supply, while to none of them is there a permanent or man-made regulator at the offtake.

(2) The water is distributed to the lands, in the flood season by all distributaries, water-courses, and lifts supplemented by temporary and occasional flood openings in the banks. The system of canals excepting the Lower Sohag Canal is an old and somewhat imperfect one. The large wasteful direct water-courses, are being gradually but slowly replaced by main or minor distributaries, on which more complete control over the supply and distribution and prevention of waste is possible. These measures will now receive a fresh impetus, seeing the Government

of India has sanctioned this group of canals being closed as Major Works, instead of Minor Works as heretofore. Under this system more liberal expenditure chargeable to capital is contemplated. The Lower Sohag-Para Canal is a comparatively recent work, on which the canals, branches, and distributaries were carried out under a project, and it is therefore a more perfect irrigating machine than are the other three.

(3) The period during which these canals are ordinarily kept open commences on the 1st of May and ends on the 1st of October. The rise of the river does not depend on rainfall, but on the melting of the snow and somewhat on the annual closure of the Sirhind Canal, which takes out at Rupar, a point higher up. The rivers may fall towards the middle of September during the years of drought, but an unfavourable year is one usually qualified by the absence of floods, more especially by their absence during the month of September or early in October. Floods in the latter are rare. The current year (1900) was characterised in this way by an absence of floods in September due to the early cessation of the rains over the Hill Tracts.

Having regard to the Khanwah and Upper Sohag Canals of this series, I would quote the following paragraph from the Completion Report. It is dated 1896:—

"It must be stated that the work of improvement is by no means completed, and that there is scope for much further expenditure with a certainty of a corresponding improvement in the return. The distribution is almost entirely effected from long, badly aligned water-courses in which the waste of water is known to be enormous and a great deal still remains to be done in shortening the channels by cutting off long bends, whereby the command can in many cases be increased and a considerable saving effected in the loss by absorption. The most urgently needed improvement is the gradual construction of new distributaries with a maximum command and under complete control, in supersession of the long water-courses, with open heads, by which the supply is now conveyed to the more distant villages and which cannot be much longer maintained, owing to the accumulations of silt on their banks, the result of successive clearances for upwards of thirty years. It is only by this means that full advantage can be taken of every rise in the river, and the available supply can be utilized to the best advantage. The cost is, however, not the only difficulty, for the people are naturally suspicious of changes of this kind, so that considerable tact and judgment is necessary in carrying out alterations. There is, however, great room for improvement in this respect, and if the questions receive constant attention, and sufficient funds can be provided, it may be confidently anticipated that the financial position of these canals will continue to improve and will be accompanied by a corresponding improvement in the condition and prosperity of the people."

13 On these canals it is not usual or practicable to double-crop the land.

The irrigation of rice is made practicable by reason of these canals. The other crops are mostly those which can be grown, were the rainfall plentiful, which it is not. The percentage of 1st and 2nd class crops is about 20. The probable average increase in the value of crops induced by the canals is one-and-a-half times. Rainfall is never ample, and early rain or drought is the prevailing condition, more especially in the Montgomery district.

The value of a crop grown on inundated land, may be deduced from the following fact:—

We were charged Rs. 65 an acre for land along the Sutlej river bank required for a new leading channel of the Lower Sohag-Para Canals, some two years ago, but we were charged at Rs. 76 an acre for the wheat crop growing on it, which was not green. The year was a very dry one.

14. If the river or canal heads fail, liberal remissions of water-rate are given for failed and immature summer crops, which may amount to 50 per cent. of the whole. The failure of floods, however, gravely affects the spring sowings, which are appreciably reduced in area. Waterings for the spring crop sowings are required after the 1st of August, but more especially during the month of September. The late rise of a river does not affect these canals to the same extent, because water is not in much demand before the month of June. The absence of floods also affects the area inundated by the spills from the river which in a favourable year force themselves far inland. Complete remissions are not granted on immature crops grown from autumn sowings for the spring crop, because the water-rate is purposely placed very low in consideration of the small value derived.

15. The irrigation on these Inundation Canals is supplemented by wells largely in the winter, as the crops get but a single liberal watering from the canals before sowing. This is the more essential in the villages of the Montgomery district which is a very dry tract. In the case of the new colonies of the Lower Sohag-Para canals it was one of the conditions accompanying the leases laid down by Government and accepted by the colonists that agricultural wells shall be sunk. The number reported up to the end of 1898-1899, as sunk under these conditions was 650, having about 93 acres on an average to each well. The areas in these colonies assessed in the said year as irrigated were as follows:—

	Acre.
Autumn crop	15,233
Spring crop	21,802
TOTAL	37,035

16. We have no statistics of a reliable nature, whence we can give this information, but we should not make a difference between years of drought and others as the former state is characteristic of the tract.

17. The average occupier's rates assessed on the Lower Sohag-Para Canals were—

	Rs.
for the autumn crop of 1898-99	1.62
for the spring crop " "	0.93

The water advantage rates were for the same crops Rs. 0.46 and Rs. 0.26, respectively.

For the three canals of the Upper Sutlej Series they were as follows:—

For occupier's rate.

Montgomery District—

	Rs.
Summer	1.67 per acre.
Spring	0.91 "

For water advantage rates.

	Rs.
Summer	0.64 per acre.
Spring	0.63 "

For occupier's rates.

Lahore District—

	Rs.
Summer	1.43 per acre.
Spring	0.50 "

For water advantage rates.

	Rs.
Summer	0.75 per acre.
Spring	0.66 "

Since the 1st of April last the water rates for the Lahore district have been raised to a level with those current in the Montgomery district. The water advantage rate in the Lahore district is assessed at 12 annas an acre on any land irrigated in the year. It may not be charged twice if the same land happens to be twice cropped in the same year.

It is not known what the cultivator pays to the owner of the land in the form of enhancement of rent, because these parties usually deal in kind, the land-owner claiming a share of the produce which may amount to one-third or even to one-half of the gross produce. The usual claim is one-fourth, in which case the tenants will pay the water-rates (occupier's). The dealings of landholders and their tenants having a right of occupancy, are subject to Section 22 of the Punjab Tenancy Act.

Water-rates called occupier's rates are assessed on the areas actually irrigated and the assessment papers are drawn up twice a year. Water advantage rates are charged on fields irrigated once a year. There is no other enhanced land revenue, that is the wet rate, charged on the holdings of these canals.

18. Statistics are not available to admit of my answering this question, but an outside limit of private expenditure to bring water to the fields would be one rupee an acre.

Probably 8 annas is a fair average, for masonry works are not common on water-courses of these canals. It is probable that landholders and their tenants join together and dig their watercourses, and that the actual transfer of cash seldom or never occurs. The lands usually require no further preparation previous to irrigation besides ploughing and the raising of small ridges, all of which are not permanent. The tenant could not claim compensation from the landlord for such ephemeral improvements. On the older systems the cost of silt clearance of watercourses is heavy and may amount to from Rs. 2 to Rs. 3 an acre. The watercourses may have to be cleared two or three times in a crop. Where Government has constructed distributaries the incidence of the cost devolves on the Canal Department in clearing these channels; that of maintaining the water-courses then becomes a nominal load only.

19. These evils are unknown in the alluvial tracts, the subject of this reference, as the canals flow for half the year only and even these lands which are subjected to severe inundation never present the appearance or condition of permanent swamps. Rain water never flows in the tracts and there are no drainage works whatever, nor are any wanted. The country, moreover, is intersected by abandoned river channels which would act as drains, if required.

20. The maintenance, repairs, and clearances are carried out through the Canal Officials, who engage contractors for clearing silt; much of the labour is indigenous but some of it is imported. The cost of maintaining the canals for direct charges is about one rupee an acre, of which about half is for establishment, and of the rest a large factor is paid for silt clearances of the main channels. On the Lower Sohag Canal a condition has been insisted on the colonists, that when required they must turn out and assist in clearing silt from the canal. The condition is rarely acted on, because payment has to be made to the labourers at a specially high rate, about double the normal, so that it is more economical to engage ordinary labourers, even were it necessary to raise the rates. The system in vogue is an ordinary one, it has worked well so far, and legislation is not required at present.

21. At the time of the annexation of the Punjab the irrigation system consisted of the Khanwah and Upper Sohag Canals, while a reach of the Lower Sohag Canal of a small size as far as Ilaveli, about 20 miles in length, was then in use. These canals followed old river arms or branches into which water was admitted by cuts from the river. All of these systems have been remodelled, extended and improved under the British Government. There are no private canals in the districts within my charge of which Government has assumed the management.

22. I would in no case, on the Punjab plains at least, encourage or assist the construction by private persons of further canals. All such should be undertaken by the Irrigation Department. Even if the canals in question were of small size, the principle of allowing private individuals to control irrigation on land, not owned by them, is wrong and is likely to involve the parties in litigation. There is no reason why the Irrigation Department should not control every possible canal in the Punjab, even those which may not appear to be remunerative. Individuals should not be allowed to acquire vested interests in water supplies.

D.—Tanks.

I am, I believe, the only officer surviving in the Punjab Irrigation Department, who has had charge of the Delhi and Gurgaon Irrigation Works, which consisted of a large number of embankments, tanks, and catchwater drains. These were taken over by the District Officials some 20 odd years ago, because a sufficient water-rate was not allowed to the Canal Department for their maintenance. The rate allowed was, I think, 6 annas an acre, and entirely insufficient for their proper care and maintenance. This retrocession was a retrograde movement, because on the whole the tanks were beneficial and worth maintaining, while they required skilled supervision, not likely to be always available under the District Officers. When in charge of these tanks, I ascertained that the effect of a good soaking over the flooded area, lying above the tanks, was sufficient to ensure good crops for several years to come. But if water were headed up, as must occur during the rains, a summer crop could not be cultivated upstream of the embankments, but a spring crop only became possible on the impounded water being released. On the whole the works were valuable and very interesting, some being of an ancient nature, handed down from the Moghul rulers.

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E.—WELLS.

In the Gurdaspur district the depth of spring level is about 18 feet, on the perennial canals.

In the Amritsar district it is 11 to 18 feet.

In the Lahore district 40 to 60 feet.

On the inundation canal tract in the Lahore district the depth is from 15 to 20 feet, and in the Montgomery district 25 to 40 feet.

The spring level has a tendency to rise in the irrigated tracts, which is in a large degree beneficial. Certain saline wells are known to be covered by proximity to canals into sweet water wells. In parts of the Amritsar and Lahore districts there is a tract where the wells are almost universally saline, which, when repeatedly used, destroy the fertility of the soil and throw it out of cultivation. The wells are in all cases supplied from perennial springs and are seldom exhausted by constant working within the sphere of canal irrigated tracts. Some wells which might be used are abandoned in the canal tracts, but such a course is not favoured by the Irrigation Department. This department is not concerned directly in the construction or maintenance of agricultural wells along the perennial canals, but we observe the spring levels twice a year on series of wells all over the irrigated tracts. It is well known from our statistics that the spring level having risen, and the volume of springs improved, well irrigation can now be more extensively practised in the regions commanded by the canals. The effect is rather to cheapen the cost of irrigation by wells, than to widen the areas irrigable from each well, as the well-blocks must be permanent to a large extent. Two years ago when the Punjab was subjected to a severe drought, many old wells in the districts commented on were re-opened and many new ones were sunk. It may be added that in the Lahore, Amritsar, and Gurdaspur districts we are charged practically identical sums for lands which are canal and well irrigated, when acquired for our works, from which I would infer that the values of produce and

other agricultural conditions are about the same in each case. It may be recollected also that on the perennial canals a certain proportion of the irrigation is by lift, and that this is about 5 per centum of the whole. It is, however, one of the aims of our Canal Officers to convert lift irrigation into flow wherever possible, because the water-rates are but half in this case, and there are certain incidental items of waste in lift irrigation which render it less desirable than would appear on the surface. At the same time I fully admit that the produce on lift irrigation is on an average higher in value than on flow, because more care, attention, and labour are applied to fields and crops which involve the cultivators in special expenses. Besides, in this case owing to the up-keep of farm cattle more manure is available for cultivation.

An agricultural well in the Bari Doab Canal tracts will fertilise a block or form of from 25 to 30 acres, but a good canal lift, the labour being less, will probably command about double the above area. It is known that wells may possibly be worked at so great an expense for the maintenance of the well-cattle, as to leave no margin for profit, but this contingency never obtains in the case of canal lifts.

All the lifts in this part of the Punjab are in the form of the Persian wheel made of country wood, the vessels consisting of round-bottom earthen pots hanging on to locally produced rope. The value of a complete effective apparatus is about Rs. 40.

No assistance is offered by the Government or by the Irrigation Department to cultivators, who wish to set up lift-wheels on these canals, nor is it necessary or advisable. The profits are so great and the initial cost so small that any ordinary cultivator can set up such an apparatus, provided the Canal Officers grant the opportunity to do so.

Temporary and unlined wells are not in use in the tracts irrigated by the Bari and Sutlej Canals. Their use cannot be encouraged in any case, as without apparatus and bullocks they would be useless, and were these available, the owners would sink permanent wells.

(22) Mr. H. F. B. Frost, M.I.C.E., Superintending Engineer, Sirhind Canal Circle.

A.—General.

Mr.
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M.I.C.E.

1. The answers refer to the portions of the Ludhiana and Ferozepur districts and Native States commanded by the Sirhind Canal. I have been in executive charge of the Ferozepur Division for 2½ years, and for 9 months I have been in charge of the whole canal as Superintending Engineer. The tract is described in the notes on Irrigation Works of the Punjab for the Commission on Famine Protective Works (1901) in pages 19, 21, note IV, and note XVI E, (IV). From these notes it will be seen that the culturable area commanded is 4,035,410 acres, of which 1,170,000 acres are irrigable at present and 920,015 acres (or 23.6 per cent.) have actually been irrigated annually on the average during the ten years ending 1900, while 1,368,528 acres (or 33.8 per cent.) are irrigated in a dry year of low supply.

2. The average rainfall in each month of the year is as follows:—

January	.	.	.	.	.	0.98
February	.	.	.	.	.	0.82
March	.	.	.	.	.	0.42
April	.	.	.	.	.	0.18
May	.	.	.	.	.	0.42
June	.	.	.	.	.	1.90
July	.	.	.	.	.	4.75
August	.	.	.	.	.	4.30
September	.	.	.	.	.	3.61
October	.	.	.	.	.	0.15
November	.	.	.	.	.	0.05
December	.	.	.	.	.	0.42

Note.—The average is calculated on the average of the 15 years ending 1900.

3. See paragraph 7 of note IV of the notes on Irrigation Works in the Punjab. It may be added that in the two large tracts which are at present not commanded for the reasons given in the notes, the demand for water in *kharij* would be as slack as elsewhere on the system (see paragraph 3 of the notes). The area irrigable from the canal in a dry season is limited by the supply available. There is no obstacle to the extension of irrigation in a dry year, arising from causes (1) to (9) except as above. In a year of moderate rainfall the area irrigated is very much less

than that irrigated in dry years, because the sandy soil retains moisture well, and large areas can be cultivated without the help of canal water. Thus on the Sirhind Canal the average area of irrigation is 67 per cent. of the maximum, while on the Bari Doab Canal (where the conditions are different in this respect) the average area is 83 per cent. of the maximum. To this extent then the nature of the soil is an obstacle to the extension of the average area of irrigation.

4, 5 and 6.—No reply is given.

7. (1) On the average, about one seventh part of the average area of irrigation has two harvests instead of one. The gross value of each crop is estimated at Rs. 28 per acre. (See the notes, table XVI E (60)). Hence irrigation increases the value of the produce of land from this cause by Rs. 4 per acre irrigated and by Rs. 0.90 per acre of culturable land commanded.

(2) More valuable crops, such as sugarcane, maize, and cotton, are grown on about one-tenth of the average area actually irrigated, replacing charri and jwar. The difference in gross value is about Rs. 10 per acre. Thus the increase in value of the gross produce due to the substitution of more for less valuable crops is Rs. 1 per acre of actual irrigation or Rs. 0.225 per acre of culturable land commanded.

(3) (a) Irrigation does not increase the yield. Crops irrigated from the canal do not produce better yield than crops irrigated from a well, or grown with sufficient rain. Irrigation enables crops to be grown and to come to maturity when the wells or rains fail. In a year of ample rainfall 608,769 acres or 15 per cent. of the culturable area commanded, was irrigated, and it may be assumed that this area would not have produced a crop, if it had not been irrigated.

(b) In a year of scanty rainfall the irrigation would be intermediates between (a) and (c).

(c) Similarly in a year of drought 83.5 per cent. of the culturable land commanded received irrigation (see note (XVI)(28)).

8. (1) In a normal term of years 920,015 acres are irrigated, and the gross produce of this area is worth Rs. 25,760,420, or Rs. 6.30 per acre of culturable land

commanded; I consider this increase in the total value of the produce per acre is due to irrigation.

2. Similarly in a year of drought the increase in the total annual value of the produce per acre of cultivable land commanded would be Rs. 9.38 calculated on 1,968,528 acres irrigated and valued as above.

9. (1) and (3). See note IV, paragraph 9. This has already been reported on, and I have nothing to add.

(2) In many cases the owner cultivates. When the land is cultivated for the owner by others, the rent generally takes the form of a share in the produce. In such cases the owner shares proportionately in the increase of the total annual value of the produce due to irrigation.

10. The tenant generally makes the watercourse in the first instance and always maintains it afterwards. The tenant also prepares the land both in the first instance and subsequently. But the expenditure so incurred in the first instance, both on the watercourse and on the land, really falls on the landlord who takes it into consideration

indirectly with other things by taking a smaller proportion of the produce or paying the whole or part of the water rate for the first crop.

The maintenance of the watercourse consists principally in occasional silt clearance in which the tenants combine and carry out themselves at times when they would otherwise be idle, and the cost cannot be calculated in money value. Similarly the preparation of the land, such as dividing the fields into compartments or "*kharis*" and petty repairs to watercourse banks is done by the tenant in his own time and is part of the labour of cultivation, and cannot be calculated in money value.

11. No damage has resulted (so far as I know) to the people, nor has deterioration of the soil occurred from any cause connected with irrigation. It may here be mentioned that with a view to reduce the chance of the soil becoming water-logged, and in order to improve the supply to portions of the tract more in need of an abundant supply, a certain tract in the Ludhiana district will in future receive canal water only during the *kharif* season in the same way as is already practised in certain parts of the Gurdaspur district. (See note III, Bari Doab Canal, paragraph 3, second part).

Mr.
H. F. B.
Frost,
M.I.C.E.

(23) Mr. T. R. Ward, Executive Engineer, Thal Survey Division.

A.—General.

I am now in charge of the Sind Sagar Canal Reconnaissance, a survey which keeps me out of doors all day, nor is it easy to refer to notes, papers or individuals for the detailed information needed to reply to the questions. I will therefore confine myself to question 1 by a note on the possibility of making extensions of the Western Jumna Canal to the dry tracts of Hissar and Rohtak, and to question 38 on the working of wells.

From question 1, I see that the Commission wish to know what opportunities I have had of becoming acquainted with my subject. I was trained at Cooper's Mill, and spent a year on ironworks in England. In India I served three years on the Sirhind Canal, making distributary channels. I was then a year on furlough at Kimberly and Johannesburg, South Africa, among mining people. I then spent 2½ years, working irrigation channels on the West Jumna Canal, before the present large extensions were made, two years on the Chenab Canal weir works and two years in the colony when colonization was started. I was then on furlough for nearly two years, spent on farms and colonies in South Africa, and sometimes at the London Electrical Technical School. Since returning from furlough in 1896 I have spent most of my time on the Chenab Canal, though I was on the West Jumna Canal for 6 months and in the Chief Engineer's office for 18 months. While in the Chief Engineer's office I wrote the notes for the Irrigation Commission. From the study of Punjab irrigation questions involved in writing these notes and from my previous experience, it seems to me that an important point for solution is how to extend the protection of irrigation to the dry tracts of Hissar, Rohtak and Gurgaon. The whole available cold weather supply of the Jumna river is used by the Western and Eastern Jumna and the Agra Canals.

The Western Jumna Canal lavishly irrigated a restricted tract for some 70 years and then as the last decade was largely extended, some of the extensions were made under the necessity to find work for the famine-stricken in 1896-97 and 1899.

It is perhaps too soon to say whether or no the canal could be safely extended further, but I think the result of the experience of working the canal in the last famine year (1899-1900) went to show that rigid attention should now be paid to the economical distribution of the supply to the tract now commanded.

This has received every attention, for in Mr. Kennedy, Government had the services of a specialist in the work of economical distribution of water, a subject he had studied and dealt with in a very scientific and practical way. He was able to superintend the remodelling of all the channels on the canal, and it now remains to work these channels with skill and ability so as to obtain the full value thereof, an onerous task as the Divisional charges me very large.

I believe on the Eastern Jumna Canal also much attention has of recent years been given to the economical distribution of the water, but it is probable that the North-Western Provinces can utilize all the water saved by themselves, but the two Provinces should co-operate to see that any supply

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available should be set free for extensions into the unprotected tracts.

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Ward,

But the quantity of water thus set free could not be very large, and probably not more than enough to irrigate the small tracts, not now irrigated within the large outer boundary of the present canals.

The possibility of an inundation canal to utilize the monsoon flood waters of the Jumna river should be studied, all the information is available in the maps, plans and river gauges of the present canals; an office with leisure to work it up alone is needed. But the gauge diagrams of the Jumna river show that in years of demand the river does not give surplus water over that needed for the present canals till very late in the *kharif* season, and this surplus only lasts a short time. I was in charge of the Head Works Division in 1896 when every drop of water was needed for the canal till well into July; there were some small floods in July, and a big one at the end of August, but by the first week of September shingle bands had been pushed across the weir and all the water in the river was used by the present canals till the following monsoon rains set in. I think that no inundation canal would be likely to fail when most needed, but it might be profitable to design such a work to be made, should another severe famine strike these districts. It would utilize the money spent on famine works, and if it could be so designed that there would be no temptation to speculate with the water of the present tract by using it on the inundation canal and so bring rain on both tracts in an adverse year, it might do useful work by providing a surplus of fodder, raising the spring water level of wells, thus placing the dry tracts in a better position to face famines. It is not a promising project, but it should be exhaustively investigated.

The question of building reservoirs in the valleys of the Jumna is also unpromising, but so far as I know there is no information available on the subject. A good reservoir would be so valuable that a reconnaissance should be made by an expert to see if there are any sites worth detailed survey.

There remains one more alternative, viz., to save some of the water now lost in absorption in the channels. This is known to be very large, and if any large part of this could be saved, considerable and very practical and safe extensions could be made. So far as I know no scientific study of how water is lost by absorption has been made, nor have I ever heard of any practical way of preventing losses by absorption on big irrigation channels. But we see that village tanks in India, at home and on the Cape and large reservoirs in all parts of the world are practically staunch. And there are good grounds to believe that a study of the subject by an expert would end in a practical method of treating channels so that these losses would be considerably reduced.

If a big saving of water could be made on the Northern Jumna, Eastern Jumna and Sirhind Canals, large extensions could be made in Hissar, Rohtak, Gurgaon and even in Bikaner, and these extensions would be so valuable in protecting these tracts from famine that the practical study of losses by absorption and how to treat the channels so as to prevent them, becomes one of the most important to be made in canal irrigation in the Punjab.

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Ward.

The question is not of such importance on the other perennial canals because the waters of the rivers suffice to protect the tracts at their command from famine, but no doubt the prosperity of these tracts would be increased if the rail supply could be made to go further. But were it not for the urgent need of water for the so-called dry tracts of the Eastern Punjab, the question might be left to the chance of a man arising with energy and ability enough to solve it in addition to his ordinary work. But as it is of such great practical importance, it should be tackled in the orthodox way, just as when a new project is to be got out for a canal, railway, or a big building, a special staff of picked men is placed on duty charged with the work of solving the particular business in hand.

E.—Wells.

With reference to question 33 on the subject of wells. The economical working of wells is a problem of the greatest importance to agriculture, as there are large areas that are protected by wells, if only they could be worked when rain falls and fodder is scarce. The Persian wheel and the rope and bucket, which are the usual methods of drawing water from a well for irrigation in the Punjab, are good appliances, but they both depend for their motive power on bullocks, and the bullocks cannot be fed in famine years; they die and the owner is ruined. In 1896 I met Lala Tej Ram, Supervisor, who told me that he had spent what leisure he could get studying appliances for drawing water from wells for irrigation, in order to improve the prosperity of the part of Rajputana from which he came, where the crops depend on wells. But Lala Tej Ram's services have been entirely absorbed in pushing on extensions on the West Jumna Canal to provide work for the famine-stricken, and I doubt if he has had any leisure even to think of the work next his heart, much less devise anything useful. It seems to me that a search should be made for a motive power that could be economically used in famine years; the appliances in use for raising the water are very practical and sound, and the improvements that could be made in them would never enable bullocks to struggle through a fodder famine, though they might make bullocks to do more useful work in ordinary years by improving the efficiency of the machine. On farms at the Cape that I know, much the same appliances are used; Persian wheel made in iron and worked by horses and mules is very popular in some parts of the Cape Colony, but pumps worked by wind mills are also used and give satisfaction. In America, too, wind power is much used for irrigation. I saw in an American journal some two years ago that wind engines were in great demand in some parts of Asia Minor for working wells. How far this is true I am not able at this moment to say. I believe they are quite practical and could be usefully used in India.

Thosun's heat is a source of power, which might be studied. We have no such motors in England, because there are many other more satisfactory sources of power and unless Government works at the problem it is likely to be for ever unsolved. But apart from other sources of power it is not even certain that the best animal power available is used. In the Thal (Siud Sagur Doab) where I am now, the Persian wheels are worked by bullocks, but unless the rainfall is sufficient to produce grass, the bullocks must be fed from the produce of the well land, whereas at all times there is grazing for camels. But the people do not use camels to draw water. They say it is not the custom, that the beam over the gearing would need raising to admit of a camel walking round the gear as bullocks

do, and that a camel is not strong enough to lift such a heavy load of buckets.

But I saw at Daria Dan Panah Station, Siad Sagar Branch, that the water tank for filling locomotive boilers was filled by a Persian wheel worked by a camel. The owner said he had long used bullocks, but the profit was small and precarious; and when he heard that camels were used at the Lodhian well he determined to try it and had found it a great success. The roof over the Persian wheel gear at this well is high enough to admit the camel to the run, but it is doubtful if the gear is best suited to the speed and power of a camel. Some study is needed to adapt the ordinary bullock worked Persian wheel to camel draught, and unless Government works at it and solves the practical difficulties and places the solution before the zamindar in a way that he can easily recognise the value of the change, none will be made. No doubt in ordinary years the bullock is much the more convenient animal, but in years of scant rainfall the camel is easier fed than the bullock, and if by his use wells could tide over such times, Government would profit by the prosperity of the people in so many ways that the expense of studying and working out the problem, supposing that it is a practical one and the well at Daria Dan Panah seems to show it is, would be justified by the good attained.

Boring Tools.

With reference to boring tools it may be useful to know that the Cape Government supply boring tools to farmers to bore for water. I believe the Government lend the tool and supply a foreman, and the farmer pays the cost of working it; but I am not now certain how the expenses are distributed between the Government and the farmers. I met farmers who had used them, and I saw the tools at work when I was in the Colony six years ago, the convenience was much appreciated, and I believe the Government was well satisfied with the results attained and was pushing the use of the tool. Politics enter very largely into questions of this sort in a Colony, but I have no reason to think that the success was due to causes that do not obtain in India.

It is conceivable that Government might under certain circumstances find it profitable to furnish power to work wells. In the great advances that have been made in the last decade in the transmission of power from prime means, it is quite conceivable that an expert in such matters working in conjunction with an expert revenue officer could work out a practical scheme to convey power to wells to work them at all seasons, or if that would not do, to supply power when a fodder famine threatened and so relieve the bullocks and save their lives as well as the crops and the farmer, and thus reduce the famine expenditure on useless works such as raising roads, etc.

In some districts wells fail in famine years owing to the sinking of the level of the subsoil water. In reports on the tanks of the Gorgson district it was said that the storage of water had raised the water in the wells over a large area.

Perhaps something more could be done in this direction by conveying and storing the waters of drainage, in good years, or even making escapes from the Jumna and Sirhind Canals into the dry tracts with the object of improving the underground waters of these tracts. It might be that such works would not be useful enough to justify their construction in a time of prosperity, but they might be planned and laid out to be dug by the famine-stricken as works that would be more useful than raising roads, etc.

(24) MR. F. E. GWYTHER, Executive Engineer, Dera Ghazi Khan District.

A.—General.

Mr. F. E.
Gwyther.

1. The following replies refer to the Dera Ghazi Khan district, which is situated in the south-west corner of the Punjab and lies within the arid tract of minimum rainfall.

My acquaintance with it extends over a period of three years as Divisional Officer in charge of the Indus (right bank) Inundation Canals.

2. The district is an extremely dry one, and the rainfall is both scanty and uncertain. During the three years I have been in it the average has varied from 1.05" in 1899-1900 to 5.14" in 1898-99 and 6.8" in 1900-1901—the last being considered a favourable year.

The normal average of previous years is stated in the Settlement Report of 1896-97 to be 8.5" distributed as

follows:—

In January	.	.	.	.	.	0.6
" February	.	.	.	.	.	0.3
" March	.	.	.	.	.	0.6
" April	.	.	.	.	.	0.3
" May	.	.	.	.	.	0.5
" June	0.8
" July	2.4
" August	1.8
" September	0.6
" October	0.1
" November	0.1
" December	0.2

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Of the four tohails into which the district is divided—the Saugarh or the most northern exhibits the largest, and the Rajanpur (to the extreme south) the smallest average.

In 1899-1900, the record for the latter over 12 months was only '14.'

3. (i) Population.

The district is, for India, a sparsely populated one: with an area of 5,000 square miles. It possesses only 401,000 inhabitants (Census 1891), yielding a density per square mile of 80: per square mile of cultivated area—250.

The bulk of the population is settled within the tract irrigated by the Indus Canals and protected from inundation by our embankments. The density is thus found to be greatest in the best irrigated tohails (Ghazi and Jannpur) where it reaches 125 and 100 per square mile of area: Rajanpur, which is badly commanded and unprotected by embankments can only exhibit a density of 45.

It is in the last-named arid tract that extensions of irrigation are most desirable and desired.

To Canal Officers this sparseness of population has always seemed to be the weak point of projects framed to increase or extend irrigational facilities—colonisation being out of the question on purely inundation canals: the doubt involved is felt to be an obstacle to assured success and to a commercial return on the money expended.

The civil authorities are however sanguine that no such obstacle would in practice exist—given the water, cultivators would quickly be forthcoming, and the hill Baluch tribesmen would soon settle down to more peaceful vocations in the low lands.

We have lately sent up a project (the Talai) for protecting and irrigating the whole of the Rajanpur tohail bordering the Indus—to cost 15 lakhs: the question has been raised whether the expenditure is desirable on an inundation system in a scantily populated area. Personally I do not experience any difficulty in accepting the views of the District Authorities on the subject. Provided the remodelled canals work fairly well, I believe cultivators will always be found, gradually at least, commensurate with the demand.

(ii) The supply of cattle is at present but little in excess of local requirements: given however, an increased demand, it is certain a larger supply would be forthcoming.

Ploughing cattle are largely imported from Baluchistan and the breed raised in the south of the district is famous.

Under this head I do not think any obstacle to extension of irrigation exists.

(iii) Manure is seldom used in the district. Except in the immediate neighbourhood of towns or villages where high cultivation and double cropping are necessary, it is not needed. The area available is large enough to allow of a regular rotation of crops, whereby land is allowed to lie fallow for a time.

Well holdings of long standing irrigated permanently from canals, use manure, of course, as far as possible, but at the outset it is not a necessity to a new project.

(iv) The soil of the tract irrigable from the Indus is everywhere suitable for irrigation and excellent; it is a loamy river deposit on which cotton and staple grains thrive. No "black" or "kappar" soil exists.

8. (v) All inundation canals are affected by the question of uncertainty of supply: the areas irrigated by them fluctuate greatly from year to year. It is seldom that supplies of water are equal to the demand; as a rule, they are either excessive (leading to flooding, waste and water-logging) or are so badly distributed over the irrigating season as to be insufficient.

In an arid district of scanty rainfall water is a vital necessity: without it cultivation is precarious—almost hopeless (wells being unworkable) during the great heat prevalent from May to September; however irregular the supply may be it is doubly welcome. In the absence of any other possible method, an inundation canal is desirable, it will every year pour a certain volume over the country, raise some crops, and induce that steady growth of population, cultivation and general prosperity which has been a marked feature of the older irrigated tracts around and in the neighbourhood of Ghazi.

Practically and generally the water supplied by such canals is ample for the maturing of a *kharif* crop and for *rabi* sowings. Every fifth or sixth year a bumper crop is obtained,—in between the found periods when a late rise of the river, or an abnormally early fall (such as occurred

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this past year) in September conduces to a small crop and large remissions for failures.

(vi) I do not think there is any lack of funds for cultivation of extended irrigated areas. Given the water, there will be ample money to finance its use.

The irrigable area is not a desert; villages, wells, etc., exist, and precarious irrigation from flood and bill torrent spills has been carried on for many years. The expenditure at the outset would be confined to making watercourses; subsequently as wealth increased new wells would be built, new land brought under the plough, and cattle imported.

The initial outlay should not prove heavy in a populated tract.

(vii) The people are distinctly conservative, and resent any increase of assessments, even when they know such increases to be fair, just and moderate. The fact is, water rates (i.e., occupiers' rates) have only lately been introduced into the district, and it is a form of revenue to which they are not accustomed. For generations they have paid no special rate for the use of water and have been lightly assessed on the ground that their irrigating supply was more or less precarious.

The increased rates both of land revenue and occupiers' were not well received, and the further increase in the latter that is desirable when the canals have been remodelled, will be regarded with disfavour.

I think, however, this feeling exists mainly among the better class, the privileged and well-to-do, who resent all infringements of ancient local customs, while equally keen on securing fresh privileges and exemptions. Among these the tribal Tumandars stand foremost.

Take the case of the Talai project mentioned above: it is generally regarded as desirable that Tumandars' "jagirs" should be assessed with water rates for the benefits of irrigation to be extended to them. They keenly desire irrigation, and have urged on the Civil Authorities most persistently the immense benefits to be obtained from the Talai scheme; but as soon as they ascertained their own pockets would be touched, and that there was no intention of giving them an expensive supply of water free of charge, they changed their attitude, they found they did not want canal water at all.

This objection is not based on any sound reasoning, and should not interfere with extensions which are designed with a view to improving the district, specially the yeoman class.

(viii) I know of no such reasons.

(ix) The extraordinary vagaries of the Indus is to a certain extent a difficulty which the district has to face. It is a difficulty common to all inundation canals, but is ordinarily prominent on the Indus. Its ceaseless western encroachments, and frequent oscillations constitute a danger, for the failure of an embankment is liable to result in the inundation of a part of the irrigated area.

The difficulty is, however, not insurmountable; it is merely a question of expense. The damage effected by such vagaries raises the cost of maintenance appreciably, but it can be removed or remedied.

(x) A lesser evil is that of water logging. Owing to an extremely improvident, uncontrolled use of water, parts of the district are swamped, and there is reason to believe a similar evil would befall new tracts awaiting irrigation.

The evil is, however, remediable: given more funds and it should be quite possible to control and limit all supplies to the demands of the areas dependent on them, while restricting those needed for water-logged tracts.

3 and 5. I am not competent to answer these questions.

6. I know of no instance in which the extension of irrigation has injured other cultivation by attracting its cultivators.

The latter will never leave their own land if they possess cultivating facilities, especially irrigation: and if they do not, it is desirable that they should take up land which can be made productive to themselves and to the public.

C.—Canals of intermittent flow.

12. The Indus canals, like all inundation canals, are merely open cuts leading from the river to the land to be irrigated. During the winter they are dry: about the 15th April (earliest) the river rising with the heat and melting snows fills them with water, and they continue in flow until September or October when the river falls to low water levels.

Mr. F. E.
Gwyther.

In also they vary from 15' bed width to 40', and in flood flow with depths varying from 7' to 10'.

The bed level at point of bifurcation from river—an important point in these canals—is fixed with reference to the old weather level of the parent stream, so as to be at or only slightly above that level. This ensures an early supply in April or May for the cultivation of high class crops—indigo, sugarcane, tobacco and cotton.

To obtain a supply lasting to the end of September or middle of October is not always feasible: much depends on the state of the river and the amount of rainfall. It is partly secured by arranging a suitable position and illustration for the intake of head reaches.

When this is very favourable, the canal may continue in flow throughout the winter months. I have known several such cases: the Sholra Canals have flowed continuously from April 1899 to October 1902, and similar instances frequently occur.

There are 14 canals under our control in the district, each having a separate intake on a river frontage of about 120 miles. Dug by native promoters before or shortly after the annexation they are, as might be expected, very faulty in design and at their best, primitive irrigating machines.

Much remains to be done towards improving them: the channels are at the present day in much the same condition they must have been in 20 or 25 years ago, and funds are needed not merely for extending irrigation but for remedying existing channels by—

- (i) improving defects to alignments,
- (ii) rebanking,
- (iii) constructing distributaries,
- (iv) controlling supplies by building permanent outlets.

All the Indus canals are now systematically graded every year and records kept of the state of each at the end of each working season.

2. From the main Government channels water is led on to the fields by open cuts, constructed and maintained by the irrigators. These watercourses are characterized by their great length, tortuosity and high spoil banks and are quite uncontrolled as to supplies drawn off.

Where the land is high and irrigable only during floods, the watercourses are frequently mere cuts in the canal banks, through which flood waters pass on to the fields.

Another form is the Persian wheel, used for lifting water in low supplies on to comparatively high fields, the "ghillar" is closed during floods and the outlet then irrigates by flow.

The system of watercourses that has been handed over to us is an extremely complicated one, the channels have been made solely to suit individual wants, and frequently cross and recross each other in a puzzling manner. The number in existence is far in excess of requirements: one canal I have been examining, showed there was on the average 1 outlet to every 50 acres of area commanded. Frequently one well holding of 60 or 80 acres is found to have a couple of outlets added by 6 or 8 cuts through canal banks.

The result of the system is a very extravagant use of water, low duties and considerable loss of revenue. It is the tail reaches which suffer most, the supply available there being on every canal in the division very inadequate.

Most of the flow irrigation is effected by means of temporary dams placed in the main channels during "tatta." By their means water levels are raised and flow rendered possible. A very large number of such dams are in use every year, complicating the system of "tatta" and rendering it difficult to supervise them with our present establishment.

There are practically no distributing channels: all watercourses feed from the main canals direct. As a consequence they are often of inconvenient length and size.

"Tatta" have to be enforced on every Government channel from head to tail except in high floods.

Only the main canals and their branches are maintained by my Department: all distributing (minor) channels are owned and kept up by irrigators.

3. The supply in the Indus canals is ordinarily maintained for—

- (a) 170 days when the rainfall is good,

- (b) 155 days when it is scanty,

- (c) 135 days, when there is no drought or failure of the monsoons.

13. As I have remarked above, water is a vital necessity in such districts as Dera Ghazi Khan on which its life and existence depends. Take away canal water and a flood swept tract remains, which would be unculturable in the hot months and uninhabitable.

It may be accepted therefore, that but for the canals there would be practically no *kharif* crop in the district which would be the poorer by, say, 140,000 acres, outturn of seeds and grains (valued roughly at 30 lakhs of rupees).

(2) Similarly the canal period of the cultivation of indigo and rice, which are purely canal crops, and could not be matured from wells. The value of outturn from these two alone amounted in 1898-99 (a poor year) to 20 lakh rupees, rice being largely cultivated and highly valued.

Of other high class crops, cotton, tobacco, poppy, sugarcane and pasturage are grown to a far larger extent than would be possible on well land, and in the same year were valued at 5 lakhs.

(3) The Revised Settlement Report shows the yield of wheat on "chahi nahar" land to be 400 mowas per acre (average), while the yield from purely inundated lands is only 210 seers—the difference being creditable to canal irrigation.

The same difference would be found in all crops culturable from wells only, the introduction of irrigation would mean an improvement of at least 60 per cent. in their yield value.

The rainfall of the district is quite insufficient to mature crops on; in a normal year wells are not so much worked and cattle get no rest in a year of drought they are constantly worked. But the outturn of cultivated land is not affected (except in the winter) by the amount of rain that falls.

The difference between years of ample and scanty rain would be merely that due to the higher prices obtained for edible grain mainly wheat, jwar and rice.

14. (1) A late opening of canals induces a shrinkage in the area of high class valuable crops, especially cotton and indigo, and the substitution of inferior crops of small value such as bajra, china and til.

A very bad year may even affect the rice crops. The season of 1901 was most unfavourable, some of the canals remaining dry till the middle of June. On this there was a considerable shrinkage in rice.

In such years cultivators attempt to make up for their bad *kharif* by watering a larger area for *rabi* sowings. Such waterings are commenced early in July.

(2) An early cessation of supplies generally affects all crops except indigo and rice which are harvested first.

The absence of water in September and at the end of August is injurious to the outturn, prevents the crops being matured and is the cause of heavy "khatals" remissions.

The winter crop is naturally affected as well, and a decrease in the wheat area results.

In 1900 we did a maximum recorded area—the river rose early and did not subside till the middle of October. The results were a large and bumper crop, both *kharif* and *rabi* with an unusually small percentage of remissions and an excellent yield.

The year was characterized by an absence of high prolonged floods, which cause breaches, floods, water logging, leading to deterioration of soil and heavy remissions.

The best years on Inundation Canals are thus seen to be those in which the river rises early, is maintained at a high level throughout, and in which there are no high floods. Such conditions would be obtained by an early hot weather, following on a cold winter and followed by a moderate sustained monsoon.

15. In the canal irrigated tract ordinarily the supply is not supplemented by well irrigation except in the following cases:—

- (1) Wheat: this is sown on canal watered land and is matured by wells, as the canals are dry throughout the winter. (Also grain and poppy).

- (2) Cotton is grown on canal water, but the final wetting is done from wells after the canals have dried. The plucking of this crop is done in November and December. (Also sugarcane).

(3) Tobacco is sown at the outset on well water, but matured when possible on canal.

17. (1) No water or other rates are usually paid by cultivators to the owners of private canals: a mutual arrangement is entered into whereby the former assist in clearing and maintaining the canal, while the latter dig it at the outset.

This was the arrangement on the Dhundi canal—an attempt on the part of the promoting syndicate to recover a water rate resulting in a deadlock and the ultimate assumption of control by Government.

(2) The cultivator or tenant does not pay the landlord any acreage rate for the benefits of irrigation: he has, however, to give him one-third of the produce of the land in kind.

(3) Land-owners are assessed with a water advantage rate varying from 8 to 10 annas an acre in addition to a fixed assessment varying in different areas from 12 to 15 annas per acre (average cultivated).

(4) No royalty is paid in this district by owners of private canals to Government.

18. The only private expenditure necessary to bring water to the fields is that due to construction and maintenance of water-courses.

The former falls on the landlord: the latter on the tenant.

The actual amount varies greatly. On the Sidhni Canal (Multan District) the construction of village minor channels was effected within a rate of As. 8 per acre commanded.

Hence I should put it at about Rs. 1 per acre irrigated.

The land is not prepared much for irrigation—the raling as to dimensions and partitioning of fields is not observed, and the husbandry is often so poor that even jungle growth is not removed from cultivated land.

19. No damage has so far resulted to the health or physique of the people from irrigation. The climate is a dry one, and the fact that irrigation only lasts for 5 months out of the 12, checks any tendency to deterioration.

With the soil it is otherwise. The long unchecked profligate use of water combined with a rather alarming growth of rice cultivation has induced water-logging in parts of the district. (Dehra Ghazi and Jampur Tehsils).

This evil is popularly attributed to the westward encroachments of the Indus—an arrangement that will not bear analysis, as the worst tracts are situated farthest from the main stream. They are found to be low-lying areas easily commanded by flow, extensively cultivated, and with a large canal supply close at hand.

The water-logging occurs from June to September, and is not very largely prevalent, but tends to increase, as the rice area increases year by year. It is stated these areas can now grow nothing else but rice.

They have been under irrigation ever since we came into the district, but the deterioration of soil seems to have occurred within the last ten years.

The remedy is, I think, an easy one. Check the wasteful use of water by controlling the private water-courses, and by limiting the size of outlets to actual requirements with permanent outlets of standard type. If this proved only partially successful, I would limit the canal supply allotted for such areas, and even impose a punitive rate on rice cultivation.

Rice is a crop that peculiarly suits the local zemindar: it is easily cultivated, requires no husbandry, and is well matured within the irrigating season: it is moreover a most profitable crop (we value it at Rs. 50 per acre). In places I have known it to give a double crop before the canals dried up.

It would be extremely difficult to undertake any drainage scheme, as the river water surface is higher than the tracts affected. Such a scheme would be costly and should be a last alternative. Where feasible I have known it to succeed admirably—for instance the water-logged villages on the right bank of the Sirhind Canal Main line were greatly benefited by a drainage scheme: but a great deal of care and attention had to be given in order to insure success.

Salt efflorescence does not trouble the irrigated tract to any noticeable extent.

20. The canals with their branches are maintained wholly by Government from head to tail. *Mr. F. H. Gwyther.*

The silt clearances are done once a year, between January and April, and are finished by the 15th of the latter month before the river rises. At the end of the irrigating season in September surveyors are sent out to map the position and main features of the Indus over a length of 100 miles (roughly)—from a base line laid down on the right bank last year.

They then level down all the Government channels and send in longitudinal sections, on which the Divisional Officer lays down suitable gradient. Estimates are then proposed, and on receipt of sanction clearances are started by contract work early in January.

The labour employed is entirely local, which benefits by the annual expenditure within the division of a sum of about Rs. 75,000.

The maintenance during the irrigating season includes watch and ward over many miles of flood embankments and along canal banks. Otherwise all work is confined to the cold weather when labour is available and cheap.

The system works perfectly well, and no difficulty exists in getting through all necessary work in time. All charges for maintenance and clearances, etc., are made to Revenue.

No legislation is necessary. The average cost of such charges is about 1-4-0 an acre: the figure is a high one, and rendered abnormal by the inclusion of charges relating to the long line of river flood embankments, and works required for training the Indus or defending its right bank from encroachments.

21. Many of the Indus Canals were constructed by private individuals or syndicates. The Masanwah and Fagalwah-Dhori were dug in 1863 and 1863, and about the same time the Nur and Dhundi Canals—the former by prominent individuals or zemindars for their own or their tribal lands—the latter by a syndicate to whom Government had conceded a large area of waste lands, in return for which they were to extend and improve these canals.

Great difficulties were experienced by these promoters in managing their property—their attempts to recover dues for extending irrigation were stoutly resisted by the cultivators—and successfully. Water was greedily taken but the right to levy rates was denied, and in all cases the promoters found their speculation so unprofitable that they had to ask Government to undertake the management.

This was eventually done about 1880, Government buying out the original proprietors.

The reason of these failures is fairly evident: the actual excavation of such channels is at the outset a matter of no great difficulty—as each village is glad enough to help. But it is otherwise with the succeeding labour of maintenance and up-keep—these the promoters over found a heavy drain on their resources which they were unable to finance. Had they the legal right to levy water rates and the power to enforce them, the collapse of their enterprise might perhaps not have come so quickly. In any case I believe it was bound to follow sooner or later. It requires an extremely strong and thoroughly impartial master to manage so necessary a commodity as water among a mixed population accustomed for generations to use it without charge as wastefully as they pleased.

Under the first settlement, even under Government control, the Indus canals worked at a loss, barely paying the cost of their up-keep.

22. I should never recommend the encouragement of private enterprise in the extension or development of irrigation—it is diametrically opposed to the interests of our Government and the general welfare.

Private enterprise can never cope with the problem, because—

(1) It lacks the necessary authority and power to enforce its rules.

(2) It cannot be impartial, Government can be so, and the cultivator knows it.

(3) The financing of such projects is difficult enough, but the succeeding maintenance is even heavier. Either it is not done and the channel falls into disuse, or its cost is a burden—especially in unfavourable years.

(4) There is a definite difficulty in scouring a return on the capital spent.

(5) The projects resulting from such enterprise are immature, badly executed, and mainly subordinated to individual influences.

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(6) It is the rich powerful landowners who alone profit by them—the poorer classes gain nothing.

In every single case I have come across, private canals have turned out failures, and Government has had to step in. The condition of affairs internally can only be described as chaotic, while externally the channel has fallen into disrepair; no method, no order anywhere—each village seeking to outwit its neighbor and attain its own ends. Such things are attempted now on Government canals, but have to be promptly checked by law and official authority; they are more openly and flagrant shown on private channels where such restraining influences are not clearly evident.

The net result of private ownership of canals is clearly discernable by those who have the opportunity of following events. The Tumandars (Biluch chiefs) desire nothing better than that the management of channels passing through their tribal limits should be entrusted to them, putting forward as an unanswerable reason the interests of their tribes; yet the practical result is that temptation is offered of absorbing water at the expense of the tribesmen.

The smaller landowner—the yeoman—would vote solid for a pure impartial official control under European supervision; also for a more efficient and scientific outlay in the initial stage on properly constructed channels.

E.—Wells.

34. (1) The average depth of permanent wells within the irrigated areas of the Ghazi and Jampur Tehsils (where 2/3rds of the canal crop is found) ranges from 12' to 16' (to water surface), and even 20'.

In the north (Sangorh) and on the western canal border, water is found at depths varying from 20' to 25'.

In the south it is reached at 14' to 25' below the ground.

These water levels vary greatly with the seasons—rising rapidly with the river, and decreasing as it falls.

(2) The supply topped by wells is from percolation: it never fails and is never too saline* to use (though frequently unfit for drinking).

These conditions obtain in the canal protected areas. In the Pachad tract—partly desert, partly cultivated by hill

* Except on the border, or west edge of irrigated tract where water is frequently unusable for irrigation.

tribes—wells are only made for drinking purposes and are very deep. This part of the district is too high to be ever commanded by the Indus waters.

(3) The average cost of a well is Rs. 300: in the Pachad about Rs. 2,000.

(4) "Pucca" wells of burnt brick are usually constructed and last a lifetime or more.

(5) The Persian wheel, single or double, is alone used here for raising water.

(6) Well holdings vary in size, they are larger near the river and in the rich canal tracts than elsewhere.

In the north about 28 acres form a holding—between Ghazi and Jampur in the centre 22 to 27—on the western border 9 and in the south from 11 to 8 acres.

(7) No purely well irrigation is done: well water generally supplements and assists the canal supply.

Under such circumstances the average cropped area varies from 24 acres in the north, to 16 and 11 in the centre, and 6 acres in the south.

In addition a portion of the holdings is irrigated from canals without the aid of well water.

38. No serious difficulties are encountered in selecting sites for irrigating wells, or in constructing them; water is met with all over the irrigable area, and wells present no difficulties.

Assistance has never been offered by Government and is not needed: natives are able to deal successfully with this subject and are to a certain extent experts at it themselves.

I do not think expert advice is necessary, or that it would help the Zamindar at all.

39. No wells are so easily constructed that it is unnecessary for Government to undertake work which the private landlord is competent and able to do, and of the advantages of which he is fully aware.

Moreover the latter would regard such action with suspicion, as being a way of increasing his land revenue.

40. Temporary wells are not common, they are used only along the river's edge, where there is a fear of a more permanent structure being carried away by erosion. They are not needed elsewhere, as even the best of them only last some 10 years. Even in a year of drought they are not needed, as the canals suffice to irrigate a minimum area.

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(25) Mr. A. J. SCRATCHLEY, Executive Engineer, Khonki Division, Chenab Canal.

A.—General.

I have had Sub-Divisional charge in Khonki Division in the years 1886-1889, divisional charge, October 1900 to date, and divisional charge, Lyallpur Division, October 1898 to October 1900.

2.—CHENAB CANAL, KHONKI DIVISION.

Statement showing average rainfall in the Gujranwala District.

Month.	AVERAGE, 1892-1893.			AVERAGE, 1893 to 1895.	AVERAGE, 1893-1894.
	TEHSIL WAZIRABAD.	TEHSIL HAFIZABAD.		TEHSIL HAFIZABAD.	TEHSIL HAFIZABAD.
	Chinawan.	Kila Ram Kour.	Jandeki.	Nanwana.	Sagar.
January	2.89	1.75	1.42	0.93	0.75
February	1.60	1.92	1.12	1.07	0.50
March	0.64	0.67	0.47	0.60	0.25
April	0.30	0.50	0.50	0.70	0.50
May	1.07	0.80	0.75	0.93	1.00
June	3.70	2.55	1.32	2.03	2.50
July	6.87	5.42	4.85	5.60	5.00
August	5.30	3.75	4.72	3.93	1.75
September	2.22	1.10	1.22	0.90	1.20
October
November
December	0.60	0.82	0.35	1.43	2.90
TOTAL	25.67	20.28	16.72	18.12	16.35

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Month.	AVERAGE 1899 TO 1901.						AVERAGE 1899 TO 1901.
	TENSIL WAZIRABAD.		TENSIL HAFIZABAD.				Rampur.
	Khanki.	Chinawan.	Sagar.	Nannana.	Vanike.	Jandoki.	
January	0.82	0.84	0.73	0.59	0.67	0.40	0.61
February	1.30	1.16	0.89	1.04	0.82	1.25	1.11
March	0.66	0.42	0.29	0.40	0.27	0.37	0.26
April	0.12	0.19	0.07	0.10	0.20	0.15	0.05
May	1.03	0.96	0.72	0.94	0.83	0.88	0.91
June	1.06	0.39	0.79	0.70	0.80	0.97	0.55
July	3.81	4.36	2.04	3.38	2.62	2.83	2.12
August	3.81	2.27	2.66	3.66	0.78	2.42	0.96
September	1.92	2.86	1.47	1.09	0.92	0.80	0.97
October . . . . .	...	0.11	...	...	0.02	...	...
November . . . . .	...	...	...	...	...	...	...
December	0.47	0.14	0.46	0.46	0.55	0.28	0.32
TOTAL	14.90	14.00	10.02	12.21	8.58	10.35	7.86

General average of the Khanki Division in—

January	1.06	July	4.30
February	1.21	August	3.50
March	0.17	September	1.52
April	0.29	October	0.02
May	0.32	November	0.00
June	1.12	December	0.52
Yearly total = 15.23			

3. I have no exact knowledge of the villages beyond canal limits. There is no scarcity of labour in the Chouab colony, but in the old villages of the Khanki division the labour is not sufficient to irrigate over 50 per cent. of the land and judging from the state of the old villages I should say that if water is extended to old villages in the Gujranwala district, which do not at present irrigate, the maximum irrigation which will be done at first, will be 30 per cent. of the village area. Up to that extent I am of opinion that labour and cattle would be forthcoming.

(2) The people generally do not use much manure, it is used principally in case, maize, and rice. I should say in canal villages about 15 per cent. of the land could be manured yearly. There is certainly not sufficient manure to maintain the fertility of the land if the whole village area were sown each year.

(3) The soil generally is a stiffish loam, with patches of very light sandy loam and kalsar soil suitable for rice.

Practically the whole of the land is eminently suited for irrigation.

7. (1) The general rotation of crops followed, runs through a period of two years beginning from a *khari* crop.

The seasons for the two years run: 1 *khari*, 3 *robi*, 8 *khari*, 4 *robi*.

Cane.—Cane is sown after a *rabi* crop of *singi*, *maina*, *turnips*, *toria*, *sarson*, and in fallow land which has been ploughed two or three times during the preceding *rabi* season, cane runs through a *khari* and *rabi* season after sowing, i.e., through two crops in the third season; low class crops, such as *charri*, *mohi* may be sown, but as a rule the land is left fallow, and in the 4th season *sarson* or *toria*, *singi*, *maina* and very occasionally wheat is sown.

Cotton.—Is generally sown on land which has borne a *rabi* crop, i.e., after wheat, *toria*, *sarson*. At the end of the first season, *singi* and *maina* is sometimes sown in the standing cotton crop, but as a rule no *rabi* sowings are made after a cotton crop. In the third season (*khari*) the cotton is allowed to spring again and a second crop is reaped or the land is left fallow if the cotton does not again spring. In the fourth season (*rabi*) are sown *rabi* crops, such as wheat, *toria*, *barley*.

Maize.—Is sown in wheat fallow and requires good land and manure.

In the second season (*rabi*) maize is always followed by a crop of *barley*, *masur*, *gram*, *sangi* or *maina*. The third

season is fallow and in the fourth season (*rabi*) is sown wheat.

Charri Bajra, Juar.—are sown after wheat, if the land is good, as in the Lyallpur division, Chenab Canal; the *charri*, *bajra*, *juar* may be followed by wheat, *masur*, *barley*, but in the Khanki division where the land is not so good and the cultivators are inferior, after *charri*, *bajra*, *juar*, nothing is sown in the second and third season and in the fourth season wheat is sown.

Rice.—May be followed by *barley* in the Khanki division but is generally left fallow till the third season when rice is again sown. It is occasionally followed by wheat when the land is suitable for wheat growing.

It is almost impossible to give definite figures for the increase in value of produce of land owing to the possibility of cultivating two crops, but I should say that it is not far short of 30 per cent.

(2) By leading to the substitution of more for less valuable crops the irrigation increases the value of the land by 25 per cent.

(3) In a year of ample rainfall irrigation would not increase the yield if the rainfall is evenly distributed, so that sowings may be made in due season and waterings may be given in due season. A rain-grown crop under very favourable conditions of rain is equal to, if not better than, a canal grown crop.

In a year of scanty rainfall the increase in value of the produce per acre sown due to irrigation would be 50 per cent.

In a year of drought the actual outturn per acre is less than in years of rainfall, but the same amount of water is made to cover more land and the selling rate of the produce is much higher.

The increase in the value of the produce of the land due to irrigation in a year of drought is 130 per cent.

The selling price of land after introduction of irrigation as compared with the price which previously obtained would perhaps give a very good general approximation to the value of the benefits given by the canal. In the village of Kabli, Gujranwala district, land was sold some 20 years ago at

Uncultivated	Rs. 5 to 6 per acre
Cultivated	„ 10 to 12 „ „

After canal water had been given for about three years the price of uncultivated land was Rs. 10 and cultivated land

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Rs. 20 to 22. After canal water had been given for about 10 years cultivated land was worth Rs. 50 per acre.

In the Chenab Colony some land sold by auction on the Tolwala Distributary near Lyallpur fetched Rs. 212 per acre, I believe, and an average price of about Rs. 150 per acre was realized. The same land would not have been worth Rs. 5 without the canal.

8. (1) The irrigation in the Khanki division of the Chenab Canal, Gujranwala district, in normal years is 50 per cent. of the total village area. Statement A is made out on the average for the division of the different classes of crops sown. The annual value of the produce per acre sown is Rs. 29.

Statement B gives a similar village, but not canal irrigated. The annual value of the produce per acre sown would be Rs. 22. The net profit per acre sown in the canal village would be Rs. 12-8 and in the non-canal irrigated village Rs. 9-8 per acre sown.

(2) In years of drought the duty on a canal is generally far larger than in years of rainfall, but the outturn per acre is somewhat less. Statement C gives details for a canal village in a year of drought based on the average distribution of the different classes sown. The annual value of the produce per acre sown is 37 and the net profit per acre sown is Rs. 22-4.

Statement D gives the same details for a village not canal irrigated, it would lose the whole of rain-sown area shown in statement B, and would cultivate a certain percentage of low class crops on its wells. The annual value of the produce per acre sown would be Rs. 38, and the net profit per acre sown would be Rs. 14. If, however, to the well area is added the area of land ordinarily sown under rain, the value of the produce in a year of drought is Rs. 10 per acre of land ordinarily cultivated.

In the Chenab Colony, Lyallpur division, district Gujranwala, and Jhang where the cultivations are of a better class than in the Khanki Division, the outturn per acre and the value of the produce are considerably more and are not far short of double that shown for the Khanki division.

9. (1) The average annual rate per acre paid to Government on account of irrigation in the Khanki Division, Gujranwala district, Chenab canal, is approximately Rs. 4-4 per acre, and in the Lyallpur division new colony Gujranwala and Jhang district, is Rs. 3-12 per acre. The rate is paid on actual area irrigated.

(2) In the Khanki division, Gujranwala district, old villages, before canal water was given the cultivators paid 1/3rd of the outturn to the owner, the owner paying all revenue charges on canal irrigated lands; the cultivators sometimes pay 1/4th of the outturn to the owner in addition to water-rate, and in some cases half the outturn and half the water rate.

All other revenue charges are paid by the owner. It is difficult to assign a money value to the above but an approximation would be:—

on non-canal land	Rs. 6 to 7	per acre
on canal land	" 10 to 14-2	" "

There is very little land given out on the half outturn system.

In the Lyallpur division new colony, Gujranwala and Jhang districts, the cultivator in some cases, pays half outturn to owner and half rates of all kinds and in other cases pay half outturn and all rates—rates of all kinds being levied here on area actually sown.

(3) No owner's rate is paid in old villages, Khanki division.

The land revenue paid is that determined by the Settlement of 1892, and is paid on all land then taxed, whether sown or not. It varies with the quality and class of land and runs from 4 annas on culturable uncultivated land to Rs. 8 on very high class land in immediate proximity to village homestead.

I have no actual figures to guide me but I believe that the enhancement in revenue on land-canal irrigated prior to 1892 may be taken at Rs. 2, as compared with similar rain-sown land.

In the Lyallpur Division new colony, Jhang and Gujranwala districts, the owner's rate will be Re. 1 per acre after the expiry of ten years from commencement of irrigation. This will be levied on area actually matured; land revenue is Re. 0-8-0 per acre on area actually matured; excess one-fourth of owner's rate and land revenue = Re. 0-6-0 per acre.

Malikhann is levied for first ten years at Re. 0-4-0 and for the remaining terms of the lease at Re. 0-6-0, per rupee on owner's rate and land revenue. This too is levied on area actually matured.

10. On land previously cultivated the average expenditure in preparing land for irrigation may be estimated as follows:—

	Rs. 4.
Construction of main and subsidiary watercourses and bridging	1 12 per acre
Levelling land for irrigation	0 8 "
TOTAL	2 4

On land previously uncultivated and with a fair amount of bush scrub, construction of main and subsidiary watercourses and bridging	1 12 per acre
Levelling land for irrigation	0 8 "
Clearing land	1 8 "
TOTAL	3 12

This expenditure is generally incurred by owner. Occasionally the small watercourses which take water to the field from the main watercourse are made by the tenant.

In the case of repairs the owner pays for repair of main watercourse while the tenants repair the branch watercourses.

Where work is done by tenant on repairs he does not receive any compensation, and when he makes the branch watercourses in the first instance he receives an abatement on the outturn paid for the first crop.

11. I have no exact figures to show whether injury has been caused to the people by irrigation. Irrigation in the Khanki division (Gujranwala district) is now of some 13 years' standing.

I was in charge as Sub-Divisional Officer when the canal was first opened. There was a large increase in malaria during the first 2 or 3 years owing, no doubt, to the breaking up of new soil.

I left the Khanki Division in 1890 and returned in 1900. I am of opinion that the people generally are quite as healthy now as they were before irrigation was introduced. The percentage of irrigation is now about one-half the area commanded. There is no water-logging visible or any general salt efflorescence.

I can give a notable instance in the Khanki division of land previously infected with salt efflorescence which has since the introduction of canal water vastly improved. I allude to the land commanded by the Yauki and Gogargala distributaries—an area of about 85,000 acres—Tebails Wazirabad and Hafizabad, Gujranwala district. Before the advent of the canal nothing could be grown on the land except in isolated patches which happened to be free from salt. After 12 years' cultivation of rice with canal water I find that the land has now improved in quality and that wheat can be grown. The improvement is not so marked as to render it possible to cultivate wheat generally, but wheat can now be grown in certain places which were formerly incapable of bearing wheat, and I have no doubt that the improvement will continue and gradually spread.

Rice thrives in *usar* land because the land is flooded and a condition of moisture is maintained.

The *usar* land contains the salts of potash, soda, ammonia and in some instances lime. These salts are fertilised in moderate quantities and are injurious only when in excess.

The persistent cultivation of rice gradually assimilates the excess of salts until the quantity is brought down to the point where wheat can be grown.

Very little manure is used by the cultivators generally in the Khanki division.

It is used principally for cane, rice and maize, but the canal in the Khanki division has not visibly deteriorated because the percentage of cultivation is only one-half the area commanded. There is therefore opportunity for allowing the land to lie fallow. The fertility given to land by allowing it to lie fallow with occasional ploughings and consequent accretion, is superior to that imparted by manure, and as long as a fair amount of fallow obtains, there need be little fear of degeneration.

In the Lyallpur division, districts Jhang and Gujranwala, new colony, the supply of water is so liberal that the cultivators are able to put under crop during the year

practically the whole of their land. There is as yet no visible sign of salt efflorescence, although the irrigation is now of about nine years' standing. Somewhat more manure is used there than in the Khanki division (old villages). The Zemindars say that the outturn is now somewhat below what it was at first, but the decrease is not yet very marked.

I have some experience of the results of draining irrigated villages from about ten years' Sub-Divisional and Divisional charge on the Western Jumna Canal. The system adopted was to clear all obstruction along the line of lowest contour—to do as little excavation as possible—in fact to make the drains purely surface, adhering exactly to the lowest line of contour, no matter how winding it might

be. Experience is altogether against artificial cuts. The general effect of the opening of the drainage lines has been altogether beneficial. Land formerly submerged or unwatered so late that sowings were restricted, is now available for cultivation. The former swamping and water-logging of the country has been enormously reduced. The health of the people has vastly improved, and land which had gone out of cultivation is again cultivated. Salt efflorescence has been reduced partly by lowering the spring level and partly by the fact that after heavy rainfall the water is run off quickly and carries with it a percentage of salt.

Mr. A. J. Scratchley.

The improvement in this respect will probably continue.

STATEMENT A.

CHENAB CANAL, KHANKI DIVISION.

Income on 1,000 acres in an average year in a village of about 2,000 acre area, canal irrigated on the average of a normal term of year.

NAME OF CROP.	Area in acre of each crop.	Outturn per acre in mounds.	Total outturn, mounds.	Rate per mound.	Total value.	REMARKS.
				Rs. A.	Rs.	
Tobacco	3	15	45	4 0	180	
Chora	20	...	...	1 0	160	
Vegetables including melons	10	...	...	25 0	250	
Sugarcane	12	24	288	3 0	864	
Cotton	80	9	720	3 0	2,160	
Makki	30	15	450	1 8	675	
Juar Bajra	120	8	960	1 8	1,440	
Moth Mungi	15	7	105	2 0	210	
Rice	150	22	3,300	2 0	6,600	
Barley	20	20	400	1 4	500	
Wheat	430	15	6,450	1 12	11,287	
Bhoosa	430	20	8,600	0 4	2,150	
Toria and Sorson	50	12	600	2 8	1,500	
Gram	10	10	100	1 8	150	
Miscellaneous	50	...	...	10 0	500	
TOTAL	1,000	...	...	...	28,626	

Expenditure incurred by Zemindars as per separate detail Rs. 16,033

12,593 or profit per acre sown is=12-8.

N.B.—For the Lyallpur Division new colony the outturn value may be doubled.

CHENAB CANAL, KHANKI DIVISION.

Detail of Expenditure by each Crop and Canal irrigated for Statement A.

Serial No.	CROP.	EXPENDITURE PER ACRE.						Total per acre.	Area.	Total cost.	REMARKS.
		Ploughing.	Seeds.	Labour.	Manure.	Water rate.	Revenue charges.				
		Rs.	Rs. A.	Rs. A.	Rs. A.	Rs. A.	Rs. A.	Rs.	Rs.	Rs.	
1	Tobacco	4	0 4	15 6	0 6	5 8	1 8	27	3	81	
2	Chora . . . . .	...	8 4	...	...	...	...	8	20	160	
3	Vegetables including melons	4	0 4	6 12	...	5 8	1 8	18	10	180	
4	Sugarcane	8	7 8	18 0	8 0	8 0	1 8	51	12	612	
5	Cotton	4	0 8	6 8	...	4 4	1 8	17	80	1,360	
6	Makki	4	0 8	7 12	1 0	4 4	1 8	19	30	570	
7	Juar Bajra	2	0 4	3 0	...	3 0	1 8	10	120	1,200	
8	Moth Mungi	2	0 8	1 0	...	3 0	1 8	8	15	120	
9	Rice	2	2 12	6 0	2 0	6 12	1 8	21	150	3,150	
10	Barley	3	1 4	3 0	2 0	4 4	1 8	15	20	300	
11	Wheat and Bhoosa	5	1 4	3 0	2 0	4 4	1 8	17	430	7,210	
12	Toria and Sorson	2	0 4	2 0	2 0	4 4	1 8	12	50	600	
13	Gram	2	0 8	1 0	1 0	3 0	1 8	9	10	90	
14	Miscellaneous . . . . .	...	...	...	...	...	...	8	50	400	
	TOTAL	...	...	...	...	...	...	...	...	16,033	

STATEMENT B.

CHENAB CANAL, KHANKI DIVISION.

Income on 1,000 in a village where there is no irrigation on the average of a normal term of year.

	Rs.
Expenditure incurred by Zemindars as per separate detail . . .	10,742
	<u>6,383</u>
	743 or profit per acre sown=Rs. 8-8.

CHENAB CANAL, KHANKI DIVISION.

Detail of expenditure by each crop for Statement B.

Serial No.	Crops.	EXPENDITURE PER ACRE.						Total per acre.	Arta.	Total cost.		REMARKS.
		Plough- ing.	Seed.	Labour.	Manure.	Charges for pulling water from well.	Revenue charges.			Rs. A.	Rs. A.	
1	Tobacco . . .	4 0	0 4	16 6	0 6	16 0	1 8	37 8	3	112 8	This is for grazing only.	
2	Chna . . .	...	...	...	...	...	...	...	...	...
3	Vegetables including melons . . .	4 0	0 4	6 12	...	16 0	1 8	28 8	50	142 0		
4	Sugarcane . . .	8 0	7 8	18 0	8 0	20 0	1 8	63 0	10	630 0		
5	Cotton { By well . . .	4 0	0 8	6 4	...	8 0	1 8	20 4	50	1,012 0		
	" rain . . .	4 0	0 8	6 4	...	...	1 8	12 4	20	250 0
6	Makki . . .	4 0	0 8	7 12	...	8 0	1 8	22 12	20	455 0		
7	Juar Bajra . . .	3 4	0 4	3 0	1 0	...	1 8	9 0	150	1,350 0		
8	Moth Maugi . . .	1 0	0 8	1 0	1 0	...	1 8	5 0	25	125 0		
9	Rice . . .	2 0	2 12	4 0	1 0	...	1 8	11 4	20	225 0		
10	Barley Barani . . .	3 0	1 4	3 0	2 0	...	1 8	10 12	60	645 0		
11	Wheat { By well . . .	4 0	1 4	3 0	2 0	12 0	1 8	23 12	170	4,037 0		
	" Barani . . .	5 0	1 4	3 0	2 0	...	1 8	12 12	50	637 0		
12	Toria and Barson . . .	2 0	0 4	5 0	2 0	6 0	1 8	13 12	25	343 0		
13	Gram Barani . . .	2 0	0 8	1 0	1 0	...	1 8	6 0	125	750 0		
14	Tara Mifra . . .	2 0	0 4	1 0	1 0	...	1 8	5 12	5	29 0		
										10,742 8		

STATEMENT C.

Mr. A. J.
Scratchley.

CHENAB CANAL, KHANKI DIVISION.

Income on 1,048 acres in a year of drought in a village of 2,000 acres. Canal irrigated.

Crop.	Area in acres.	Outturn.	Total outturn.	Rate per Maund.	Value.	Total value.	Expenditure.	Total expenditure.	TOTAL.
				Rs. A.	Rs.	Rs.	Rs.	Rs.	Rs.
Tobacco	8	12	36	4 0	144	...	...	81	...
Chara	50	...	...	1 8 per canal.	600	...	...	400	...
Vegetable	10	...	...	30 0 per acre. per maund.	300	...	...	180	...
Cane	15	20	300	4 0	1,200	...	...	765	...
Cotton	60	8	450	3 0	1,440	...	...	1,020	...
Makki	30	12	360	3 0	1,080	...	...	570	...
Juar, Bajra	150	7	1,050	3 0	3,150	...	...	1,500	...
Rice	100	20	2,000	3 0	6,000	...	...	2,100	...
Barley . . . . .	...	...	...	...	...	...	...	...	...
Wheat	500	12	6,000	3 0	18,000	...	...	8,500	...
Bhoosa		20	10,000	0 12	7,500	...	...	...	...
Toria and Sarson	50	10	500	3 0	1,500	...	...	600	...
Miscellaneous	80	...	...	12 0	960	...	...	640	...
	1,018	...	...	...	...	39,874	...	...	16,866

Net income, Rs 23,618 or profit per acre sown = 23-4.

In the new colony, Lyallpur division, the outturn and value are mostly double the amount shown for the Khanki Division.

STATEMENT D.

Income in a village of 2,000 acres not canal irrigated in a year of drought.

Crop.	Acres.	Outturn.	Total outturn.	Rate per Maund.	Value.	Total value.	Expenditure per crop.	TOTAL.
				Rs. A.	Rs.	Rs.	Rs.	Rs.
Tobacco	2	10	20	4 0	80	...	75	...
Chara	20	...	...	1 8 per canal.	240	...	200	...
Vegetable	2	...	...	30 0 per acre per maund.	60	...	57	...
Cane	5	21	120	4 0	480	...	315	...
Cotton	30	8	210	3 0	720	...	607	...
Makki	20	12	240	3 0	720	...	440	...
Juar, Bajra	60	8	480	3 0	1,440	...	840	...
Wheat	150	12	1,800	3 0	5,400	...	3,562	...
Bhoosa . . . . .	...	20	3,000	0 12	2,250	...	...	...
Toria and Sarson	20	10	200	3 0	600	...	275	...
Miscellaneous	20	...	...	20 0	400	...	300	...
TOTAL	329	...	...	...	...	12,900	...	6,671

Net income, Rs. 5,718 or profit per acre sown = Rs. 14.

(28) Mr. W. E. T. BUNNELL, Executive Engineer, Ludiana Division.

A.—General.

Mr. W. E. T. Bunnell. That portion of the Ludiana district irrigated by the Sirhind Canal.

I have been in charge of the Ludiana division, Sirhind Canal, for the past 23 months.

2. The average annual rainfall for the eight years, 1893-1894 to 1900-1901 is 20.96 inches. Excluding the three dry years 1893-1896, 1896-1897 and 1899-1900, the average which represents the "normal" rainfall, is 20.62 inches.

The average rainfall in each month of the year is given in the following statement:—

Months.	Average of 8 years ending 1894-01.	Average of the 8 years 1893-01, 1894-02, 1895-03, 1896-04, 1897-05, 1898-06, 1899-07, 1900-08. (=Normal).
April	0.31	0.37
May	0.31	0.32
June	2.02	2.79
July	6.16	7.01
August	4.92	5.08
September	3.48	5.28
October	0.03	...
November	0.01	0.01
December	0.39	0.53
January	1.22	1.47
February	1.11	1.48
March	0.11	0.16
	20.96	21.62

3. (1) No. The district is well protected.

(2) The supply of cattle is limited and only sufficient for the present irrigated area.

(3) The supply of manure is limited. There is barely sufficient for the existing area of the better kind of crops such as sugarcane, etc.

(4) The soil, generally, is suitable. There are very patches and ridges of soil in places, which prevent extension of irrigation as the drift soil during the dry months of May and June would choke up the channels.

There is no black cotton soil in the district.

There is, however, no room for extension of irrigation.

Practically speaking, the bulk of the district to the south of the North-Western Railway is commanded by the Sirhind Canal. The non-irrigated area is confined to a strip, 6 to 10 miles wide, lying along the left bank of the river Sutlej.

(5) The supply is abundant during the harvest season usually falls during the month. The Sutlej river from which the Sirhind Canal takes its supply usually begins to fall rapidly towards the end of October or beginning of November, and if the monsoon rains have been below the normal, the supply from about the 10th of November is insufficient for the den and for early irrigation.

(6) I believe there is sufficient capital amongst the Zemindars to apply canal water to their fields, if supplied to them in sufficient quantity.

(7) Usually, there is no such fear, but when a serious settlement is pending, the irrigators restrict the cultivation of the higher classes of crops and even cultivation, generally for a year or two beforehand.

8. No; not in this district, as the non-irrigated tracts are protected by wells, and supplies can reach such tracts easily.

In years of drought, people come from the Hissar district and from Bikaner and such other arid tracts.

As stated above in reply to 3 (4), the greater part of the district to the south of the North-Western Railway is commanded by the Sirhind Canal. The tract along the left bank of the Sutlej or "Het" has a high spring level. There are, however, one or two patches within the irrigated boundaries which are not well commanded by existing channels, (e.g., Ranit village near the head of the Sutlej Navigation Channel) and for which the people have asked for either a new irrigation channel or the extension of an existing one. These tracts are, however, of small area.

The people will generally take as much canal water during ordinary and dry seasons as we can give them.

B.—Canals of continuous flow.

7. Crop for crop; there is little difference in the value of the produce of crops raised by canal and well water, provided there is a sufficiency of waterings in both cases, and that the quality of the well water is suitable for irrigating the crop and that the soil is the same in both cases and is of good quality. Where the soil is poor, light and sandy, well beating canal water will probably improve it and produce a better crop than well water would. Well water also varies a good deal in fertilizing quality, i.e., certain qualities are only suited for irrigating certain kinds of crops. Thus blackish water will only raise tobacco successfully. But for the better class of crops—such as sugarcane—manure is wanted in both kinds of irrigation.

(1) The increase due to having two harvests instead of one may be reckoned at 1½:1. But unless there is a sufficiency of manure, it is absolutely necessary to allow the ground to lie fallow for at least one season every two years on double-cropping land.

(2) 1½:1.

(3) (a) No increase.

(f) 1½:1.

(c) 2:1 or even 3:1.

8. (1) About Rs. 10 per acre per annum.

(2) About Rs. 20 to 40 per acre per annum.

9. (1) Water rates are as follows:—

	PER ACRE.	
	Flow, 100	Per.
	Rs. A.	P.
Class I.—Sugarcane, rice	5 7	2 0 Crop.
" II.—Maize, indigo, tobacco, vegetables, garden	4 8	3 0 Ditto.
" III.—Cotton, flax, all types of crops (except sugarcane and tobacco)	2 12	2 2 Ditto.
" IV.—All kinds of crops not specified above and only crops of gram and maize	2 10	1 12 Ditto.
" V.—A single watering before ploughing, followed by a crop	0 12	0 1 Each watering.

(Note.—There are no water rates on the Sirhind Canal.)

9. (2) The majority of the irrigators in this district are owners of the land irrigated, the individual holdings being small. Where there are tenants the latter give the owner one-third to one-half of the produce of their fields in lieu of rent—it may be taken as equivalent to from Rs. 12 to 20 per acre per annum.

(3) Not current in this district. Water-rates under (1) and payments under (2) are made on the area actually irrigated.

10. It is necessary to make a water course and its branches to carry the water from the Government distributary or channels to the fields. The cost is not very great. The watercourses do not exceed 2 miles in length, costing, say, Rs. 50 to 60 per mile.

The land does not usually require much treatment. "Ak" and other jungle growths are removed where found. But usually the ground is fairly clear.

The tenant, as a rule, makes the watercourse and clears the land himself. If he does not, he has to pay the cost of both the watercourse and the clearing operations, but as a 'set off' for the first two years he only pays the landlord one-third of the total produce and the latter finds the money for the canal water-rate.

(Note.—The actual irrigator is primarily responsible to the Canal Department for the payment of the water-rate and the bill is made in his name, not the owners'.

Usually, i.e. after the water-course has been in use over two years, the tenant subscribes one-half and the landlords one-half the water-rate, the landlord taking one-half the produce of the land. When canal water is abundant the tenant pays up to Government the whole of the water rate, in addition to giving the landlord one-half the produce. When the supply of canal water is insufficient, the landlord and the tenant subscribe the water rate in equal shares, but the latter only gives two-fifths of the produce of the fields to the former. The proportion of produce given by the tenant to the owner and their respective shares of the water rate vary in different parts of the district and according to the quality of the soil.

11. The people when abundantly supplied with canal water are apt to a certain extent to become lazy and less energetic. No detriment to health has resulted in this district from canal irrigation alone, but in a wet year like 1900, there is great deal of malarious fever.

The soil becomes less fertile and productive from repeated canal waterings and requires the application of manure for the better classed crops.

In the upper tracts near the bifurcation of the British branches of the canal, the spring level has risen considerably (probably 20 feet on the average) since the construction of the canal. The area affected may be put down at about 80 square miles. The soil, is, however, not water-logged and no complaints have been received from the people on this score.

The entire closing of the upper distributaries would probably stop any further rise in the spring level. The Local Government have recently issued orders for the closing off of five of the upper distributaries during the *rabbi*, i.e. from the 16th October to 31st March, with effect from 1902.

Irrigation in the affected area began in 1835-86. The rise in spring level has been taking place, it is believed, intermittently ever since. Careful observations show that during the five years, 1895-1899, no serious rise took place, but a very marked rise occurred in 1900 during the monsoon months. This was no doubt due to the abnormally heavy rainfall of July, August and September 1900.

The following deductions may be drawn from the above facts:—

(1) After the construction of a canal and the free application of canal water to the land, the spring level will rise quickly.

(2) A succession of dry years has little or no effect in lowering the spring level in each a tract.

(3) A wet year following even a succession of dry years, will cause the spring level over a freely canal-irrigated area to rise suddenly and markedly.

I have had no experience of draining irrigated land.

D.—Tanks.

23. There are no irrigation tanks in this district. But certain village tanks are filled by permission with canal water for domestic purposes and watering cattle by the Zemindars' water courses before the hot weather begins.

E.—Wells.

24. (1) The depth of permanent wells varies greatly—increasing the farther we go to the south-west. Near Ludhiana and at the head of the British branches, the depth may be taken at about 40 feet, whereas they are 60 to 70 and even 80 feet at the lower end of the division.

(2) Supply due to springs aided by percolation of canal water. The supply is permanent and in most cases remains sweet.

(3) From Rs. 400 to 600.

(4) 30 to 40 years.

(5) By a "Charsa" or leather bucket attached to a rope worked by bullocks.

(6) 10 to 20 acres.

(7) 10 to 12 acres.

35. (1) (2) (3). On the average well irrigation increases relatively the produce of land to about 80 per cent. of the increase due to canal irrigation—see reply to question 7.

36. Eighty per cent. of increase due to canal irrigation—see reply to question 8.

(38. (1) Not often, but sometimes.

(2) In the upper tracts of the district, the canal supply has raised the spring level, which entails extra expense and difficulty in sinking wells.

No assistance has, so far as I know, been offered by Government and I do not think it necessary in this district.

39. No. Government aid is not required, and I think the people would object to Government building permanent wells in their land.

40. There are no temporary wells in the canal irrigated area. There are a few in the "Bet" on the banks of the river Sutlej.

The district is so well commanded by the canal that even in a year of scanty rainfall, temporary wells are not required.

Mr.
W. H. T.
Bunnell.

(27) Mr. R. EGERTON PURVES, Executive Engineer, Karnal Division, W. J. Canal.

A.—General.

1. Q. The answers herein following refer to the Karnal district unless otherwise expressly stated. I have been full four years in this division, which practically represents the Karnal district. The reasons have varied from famine to plenty, there having been one famine year, another of scarcity and others of more or less normal conditions. I have completed distributaries extending irrigation into tracts hitherto unprotected by this canal, and have remodelled the older distributaries with the object of economising the supply and securing a more even distribution over the tract. I have been regulating the supply of this canal and am acquainted with the conditions of river supply and the quantity of water available at different times of the year. The

working of the drains excavated by the Irrigation Department and their extensions have come under review. The notion of hill torrents has been especially examined by me, and I have been frequently required to advise the District Officer professionally regarding the working of the Saranti Canal (a private canal) taking out of one of the hill torrents. I have seen the condition of the crops grown in the district and have studied the requirements of my division.

2. The following statement gives the average rainfall, month by month of one station in the Umhalla district and of 7 stations in the Karnal district as recorded by the Irrigation Department.

Mr. R.
Egerton
Purves.

Mr. R.
Egerton
Parsons.

Statement of average rainfall, month by month.

Crop.	Month.	Umballa district.	KARNAL DISTRICT.							
		Dadapur.	Indri.	Karnal.	Mansik.	Minna.	Mundel.	Jalmana.	Pagan.	Average of seven stations, Karnal district.
Kharif.	April . . .	0.26	0.40	0.21	0.18	0.10	0.47	...	0.12	0.21
	May . . .	0.72	0.52	0.51	0.25	0.49	0.56	0.07	0.31	0.39
	June . . .	6.22	3.80	3.33	2.78	2.15	2.53	2.27	1.78	2.66
	July . . .	11.64	10.23	7.22	5.03	4.08	6.02	4.61	4.44	6.08
	August . . .	12.21	6.67	5.60	3.68	3.62	3.67	4.77	3.06	4.14
	September . . .	5.49	6.26	4.61	5.34	6.02	4.76	3.43	2.74	4.46
TOTAL IN KHARIF MONTHS.		38.64	26.80	21.51	17.26	16.36	18.01	15.18	12.45	18.24
Rabi.	October . . .	0.20	0.01	0.03	0.07	0.09	...	0.17	0.06	0.07
	November . . .	0.50	0.34	0.38	0.11	0.16	0.33	...	...	0.19
	December . . .	0.93	0.73	0.66	0.68	0.51	0.48	0.17	0.41	0.62
	January . . .	1.70	1.23	1.42	1.02	0.60	0.89	0.21	0.20	0.81
	February . . .	1.57	1.46	1.82	0.73	0.55	0.91	1.10	0.74	1.05
	March . . .	0.52	0.49	0.29	0.35	0.26	0.52	0.65	0.22	0.37
TOTAL IN RABI MONTHS.		5.60	4.34	4.60	2.98	2.17	2.95	2.83	1.66	3.01

The rainfall at Dadapur has been introduced in the statement above by way of comparison; but the figures have not been included in working out the average figures of the Karnal district.

The accompanying plan* of the Karnal district shows the positions of the recording stations selected. Indri, Karnal, Mundel and Minna are along the upper line of canal

irrigated tract. Mundel, Jalmana and Pagan give the rainfall figures of the dry tracts which have recently received irrigation. The records of Jalmana and Pagan do not go back for the same number of years as the others do. The figures supplied may be considered to fairly represent the average rainfall of the district within the irrigated tract.

2 (1) The figures showing the density of the population in the following statement have been taken from the Census Report of 1901.

Statement showing the density of population (Census 1901.)

Tehsil.	AREA IN SQUARE MILES					POPULATION.			AVERAGE POPULATION PER SQUARE MILE				REMARKS.	
	Total.	Rural.	Culturable area.	Cultivation		Rural.	Urban.	Total.	TOTAL AREA.		Culturable area—Total pop. '01.	Culturable area—Total population.		
				Irrigated.	Uncultivated.				Total pop. '01.	Total pop. '01. per sq. m.				
Karnal	823	822	713	175	22	821	225,600	22,543	248,143	301	276	219	573	1 1 1 1
Faridkot	472	419	222	153	17	225	122,543	22,523	120,066	278	425	541	333	
Kaithal	1,293	1,231	1,119	130	52	773	245,122	29,223	274,345	195	273	223	210	
Thanesar	553	523	455	22	22	334	157,043	19,531	176,574	316	315	315	518	
District as a whole . . .	3,149	2,971	2,711	453	1,172	1,872	730,322	89,735	820,057	258	270	277	504	

The figures of density of population for the canal irrigated tract are not available but the following figures give some idea of the canal irrigated tract. The percentage of irrigated area to the culturable area is in—

Karnal Tehsil	22
Faridkot Tehsil	63
Kaithal Tehsil	17.

The average density of rural population per square mile of irrigated area is—

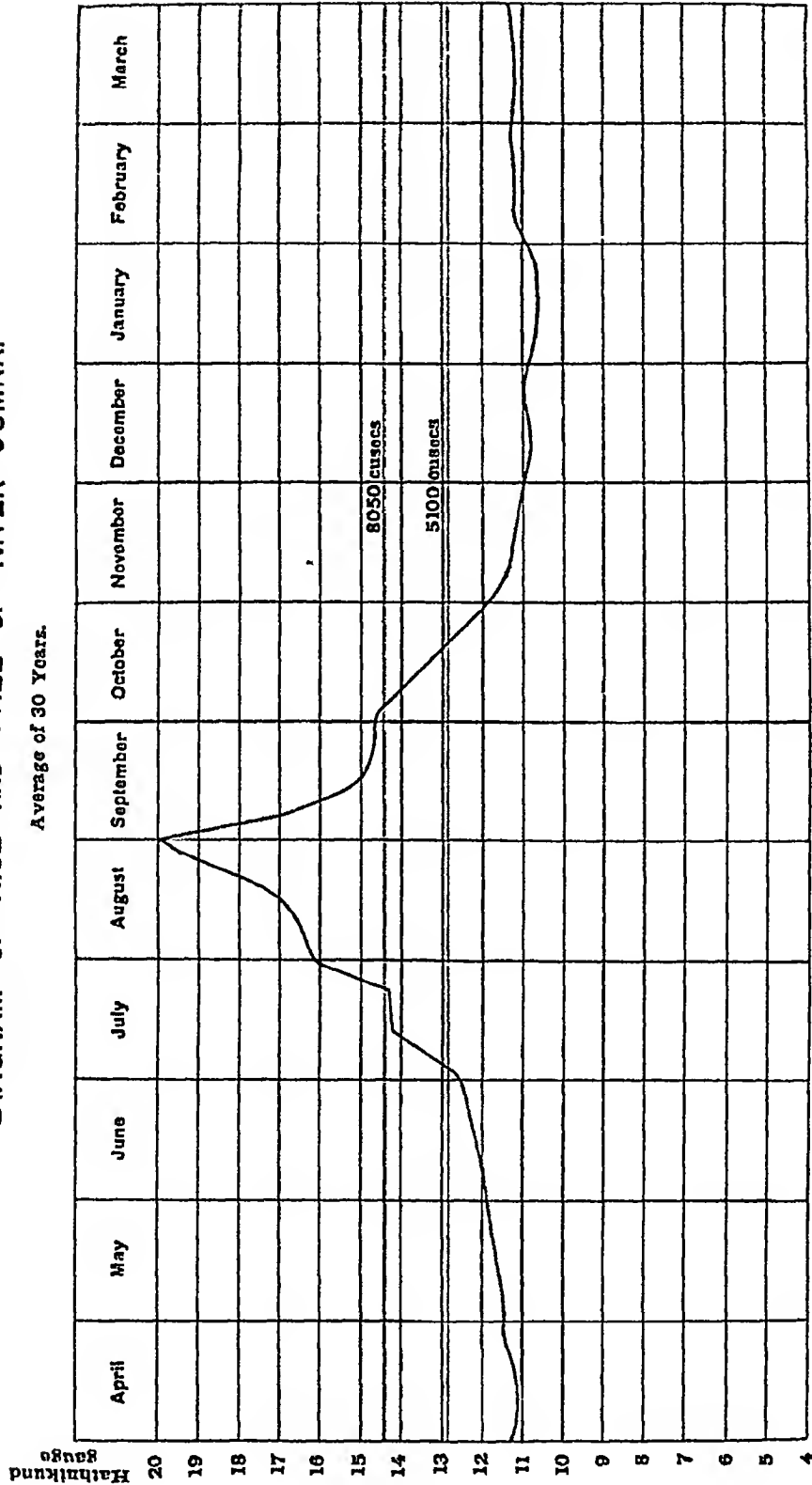
Karnal Tehsil	1,364
Faridkot Tehsil	877
Kaithal Tehsil	1,290.

The present irrigated area in the Karnal Tehsil might be increased by 50 per cent. without reducing the average population per irrigated square mile to less than the prosperous Faridkot Tehsil; and, similarly the present irrigated area in the Kaithal Tehsil might be increased by 50 per cent. The Thanesar Tehsil is not commanded by the canal and has not therefore been considered. From the figures given, it may be concluded that there is no obstacle to extending irrigation in the Karnal and Kaithal Tehsils from fear of sparsity of population; although it must be admitted that the figures are not very convincing.

2 (2) There may possibly be an insufficiency of cattle suited to well-irrigation, but for an increase of canal

DIAGRAM OF RISE AND FALL OF RIVER JUMNA.

Average of 30 Years.



0 Zero of Gauge. R. L. 1074.82 5th July,
" " 25th July, } Full supply W. I. C. } Full supply E. I. C.
" " 5th October, }
" " 20th October,

R. E. PURVES.
25th December, 1901.

irrigation there would be no difficulty experienced in this respect. The loss of cattle during the last famine was in this district nothing like so great as elsewhere, and there is no reason to believe that the stocks have run down. Parts of this district have for years been grazing grounds and naturally also the nurseries for cattle for the plow and draught.

3. (2) There are at present unlimited stores of old manure at the sites of every village in the district. Manure is but slightly used by the agriculturist. It is only in the vicinity of the towns and large villages that manure is to some extent used for *do-fusli* and more valuable crops. The high mounds of manure at most villages are abundant testimony of the vast stores in hand.

3. (4) The culturable area in the district is 2,701 square miles out of a total area of 3,149 square miles [see statement in reply to Q. 3. (1)]. The irrigated area is only 580 square miles. In other words, 86 per cent. of the total area is culturable and only 21 per cent. of this is irrigated. Also the cultivated area is 1,752 square miles or 65 per cent. of the culturable area of the district. There is a good field here for expansion, but it must be gradual. There is no immediate need for rapid progress in this district, as a whole. There are parts in the Thanesar and Kithal Tehsils, on the other hand, which require early attention.

3. (5) The river Jumna at Tajnala supplies the Eastern and Western Jumna Canals. The Western Canal Officials regulate the supply between the two canals. The Eastern Canal has a right to 3rd, and the Western Canal to 3rds of the available supply. The full supply discharge of the Eastern Canal is 1,700 cusecs, and that of the Western Canal 6,350 cusecs. When the river supply is 8,050 cusecs and over, both canals can get full indent up to full supply. When the river supply falls below 8,050 cusecs and is still above 5,160 cusecs, the Eastern Canal continues to draw full indent up to full supply, and the balance goes to the Western Canal, whatever may be its indent. When the river supply falls below 5,160 cusecs, the available supply is shared by both canals according to the prescribed shares of 3rd and 3rds.

The diagram accompanying shows the rise and fall of the river Jumna at Hathni Kund on the average of 30 years. From a discharge table of the river supply at Hathni Kund the gauges corresponding to the discharges of 8,050 cusecs and 5,160 cusecs, are 14.3 and 12.85, respectively. These figures are near enough for a general consideration of the question. Two red lines have been drawn on the diagram to show on the average the time when the changes in the methods of regulation take place. It will be seen that the Eastern Canal can receive full supply from 5th July to 20th October or for 106 days in the year. Whereas the Western Canal can receive full supply from 25th July to 6th October or only for 71 days in the year. Presuming that the Western Canal has fully utilized the available supply in the river, there remains on the average surplus water for, say, 70 days from 6th July each year.

I have not had time to plot a diagram showing the average supply taken by the Western Canal which might help to show if there be any surplus water in the river not already utilized. These averages are helpful but cannot clear the ground fully, as there are years when the river falls much below normal and during the same years the demand rises and is not met. Again, there are wet years in which there is plenty of surplus in the river but the demand is slack. The following particulars regarding the past nine years will be found interesting and useful:

1893.

Supply was sufficient to meet the indents of both canals throughout the year. The maximum supply drawn off was—Western Jumna Canal 4,351 cusecs, Eastern Jumna Canal 1,687 cusecs.

1894.

Supply was sufficient to meet the indents of both canals throughout the year. The maximum supply drawn off was—Western Jumna Canal 5,149 cusecs, Eastern Jumna Canal 1,620 cusecs.

1895.

Supply was sufficient in the spring to meet the indents of both canals. In the autumn, supply failed on 14th October when the indent of the Western Jumna Canal was 5,917 cusecs and the indent of the Eastern Jumna Canal 1,417 cusecs. The maximum supply drawn off was 7,601 cusecs for both canals during the *kharif*.

1896.

Supply was insufficient throughout the spring until 1st July. In the autumn, supply failed on the 13th October when the Western Jumna Canal indent was 6,178 cusecs, and the Eastern Jumna Canal indent was 1,687 cusecs. The maximum drawn off by both canals in the *kharif* was 7,957 cusecs. The river was very unfavourable for the Western Jumna Canal and a deficiency of supply occurred in August. Extensive *bands* had to be made to force the supply to the Western Headworks.

1897.

Supply was insufficient throughout the spring until 15th July, when the indents were first met. In the autumn, the supply failed on the 14th October, when the Western Jumna Canal indent was 5,788 cusecs, and the Eastern Jumna Canal indent was 1,930 cusecs. The maximum supply drawn off by both canals in the *kharif* was 8,286 cusecs.

1898.

Supply was insufficient throughout the spring until 1st July, when the indents were first met. In the autumn, the supply failed on the 6th October when the Western Jumna Canal indent was 5,917 cusecs, and the Eastern Jumna Canal indent was 1,733 cusecs. The maximum supply drawn off by both canals in the *kharif* was 7,957 cusecs.

1899.

Supply was insufficient throughout the spring until 1st June when the indents were first met. In the autumn, the supply failed on the 20th August when the Western Jumna Canal indent was 6,178 cusecs and the Eastern Jumna Canal indent was 1,687 cusecs. The maximum supply drawn off by both canals in the *kharif* was 7,865 cusecs.

1900.

Supply overtook the indents of both canals on 3rd April when the Western Jumna Canal indent was 3,415 cusecs, and the Eastern Jumna Canal indent was 1,642 cusecs. In the autumn, the supply was equal to the indents of both canals, and there was no failure of supply. The maximum supply drawn off by both canals in the *kharif* was 7,865 cusecs.

1901.

In the spring the demand was very slack, and there was sufficient water in the river to meet the combined indents. In the autumn the supply was insufficient on the 11th October. The supply to the Western Canal failed on the 4th September when there was plenty in the river. It has been the worst year for the Western Canal since 1875 when the Headworks were built. Extensive forcing *bands* were started early and the supply in the Western Canal was in defect throughout the autumn. At one time the deficiency amounted to 3,700 cusecs, and the average deficiency from 3rd September to 11th October was nearly 1,500 cusecs daily and thereafter the river supply was insufficient. In a year of great demand the average supply received by the Western Jumna Canal was about 4,850 cusecs, while the Eastern Jumna Canal was able to draw off full supply, 1,733 cusecs, until 20th November.

Summing up, there appear to be about 4 years in 10 when the river supply is sufficient in the spring to meet the indents of both canals, but as a general rule there is not much to spare in the river at any time from October to July.

The Western Canal has a maximum *kharif* discharge of 6,350 cusecs and the winter supply is on the average 2,800 cusecs or about 36 per cent. of the maximum *kharif* supply. This being so, there is not much scope for expansion even in the *kharif* unless the disproportion of supply in the two crops is still further increased. I think that the river supply is not favourable to any large extensions. In all there are about 70 days in which an increase of supply might be obtainable.

3. (6) There is no obstacle to extension of canal irrigation on account of lack of capital for the initial expenditure. The expenditure is incurred by the owner and the owners of land in this district are quite prepared to borrow to meet the initial expenditure.

3. (7) There does not appear to be any fear of enhancement or revenue assessment in the minds of the people. As a general rule the people take canal water freely. It is only when flow irrigation is difficult that any disinclination is shown to taking canal water, but never from any fear of enhancement of rents.

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3. (9) Extensions of irrigation in this district are possible. The supply is now allotted at the rate of 50 per cent. to older parts of canal, and at the rate of about 30 per cent. of the gross commanded area to the dry tracts, i.e., to the recent extensions of Sirsa Branch and Nardak Distributary. In view of the fact that there are large tracts in Hissar and Rohitak to which irrigation should be extended, I think that further extensions in this district should not be made at present. On the other hand I think that more water should be made available for extensions to the unprotected dry tracts. This can be done in two ways. First, by restricting the rabi irrigation on this canal in the Khadri villages some of which are in this division, and the rest in the Delhi division; secondly, by restricting the winter supply of the Eastern Jumna Canal. The first of these is a provincial question which I have no doubt the Local Government will, in due course, consider. The second means of augmenting the winter supply to this canal is an Imperial question, and the time is ripe for considering what can be done in this way. A revision of the shares of the two canals of 3rd and 4th to the Eastern and Western Canals, respectively, should certainly be taken up. Probably the best way of securing a restriction of supply of the Eastern Jumna Canal would be to 'tail' for short periods during low river. A beginning might be made by running the Eastern Jumna Canal fully for, say, 15 or 20 days in each month from October to June, whenever the demand becomes keen enough to require this arrangement. The additional supply thus secured could go to the dry tracts on this canal. This would certainly be a better arrangement administratively for the Eastern Jumna Canal than the present; for, there are, no doubt, greater advantages in running full for a short time than in running full time with a diminishing supply.

I think that without some augmentation of supply the present state of the river supply does not permit of any large extensions. It is politically unwise to extend too much. Extension may bring in large harvests in years of normal rainfall, but in years of drought and of scanty rainfall, the yield diminishes and the minds of the cultivators are distressed and turned against the canal administration. This canal has been extended in recent years and more recently still, extensive remodelling of distributaries has been carried out. The people have not yet settled down to the new order of things, and, therefore, it would be wise to consider carefully each extension. As a matter of fact the Canal Administration is gradually evolving new methods of economical distribution and each step in the march of progress widens the scope of usefulness of the canals. A consolidation of the conditions at the present stage will but strengthen our lands when the time is ripe for the next move.

6. In this district the tendency to attract cultivators from the unprotected tracts to the irrigated areas is not very great. There is always a certain flow towards the irrigated tracts, but this is usually confined to those cultivators who have marriage relations with the residents of the favoured areas. Thus before the Nardak Major Distributary was constructed in dry years, cultivators in the Nardak tract moved either on to the Hansi Branch or the more recently constructed Sirsa Branch.

When the Chenab Canal was first opened for irrigation and there was spare water passed down to consolidate the partially constructed banks of incomplete branches, cultivators were attracted from the Jhang and Montgomery districts in large number. In these cases the water was free and the virgin soil needed little attention to produce paying harvests. A good instance of this occurred in 1896 on the Jhang Branch of the Chenab Canal, where the cultivators of the Jhelum "Net" left their estates and went in for temporary irrigation on the Chenab Canal. The Deputy Commissioner of Jhang complained that the effect of this was to render it impossible for him to recover his fluctuating revenue.

We have recently converted the Chantung Drainage, into a canal, to be supplemented in the *Kharif* when there is water to spare from the Sirsa Branch. The cultivators of this tract evince a strong desire to get canal water for both crops, whereas they get it only in the *Kharif*. In years of ample rainfall, the demand for canal water is slack, very slack at present, and it is only in dry years that the demand is very strong and keen. Judged by this standard, it may be assumed that the desire for increased irrigation facilities is not great at present.

C.—Canals of intermittent flow.

12. There are two canals of this class; the Chantung, constructed and managed by the Irrigation Department

and the Sarauti, constructed and managed by the District Board.

The Chantung Canal.—This canal is primarily supplied by water obtained from the Rakabi, Chantung and Kali Nadi, which are hill torrents flowing intermittently in parts of the Umballa and Karnal districts. The supply is uncertain and irregular. Arrangements have been made to supplement the canal supply in the *Kharif* only, when there is surplus water in the Western Jumna Canal from the Sirsa Branch. In other words this drainage canal is an escape of the Western Jumna Canal.

Two drainages have been canalized and carried on to the ridge of the tract. Distributaries have been constructed and permanent outlets of large capacity built. The distribution contemplates utilizing 310 cusecs, while the canal itself is capable of discharging 692 cusecs, meeting the surplus. The cultivators have excavated water courses and the supply is distributed to the land in the ordinary manner.

In a year of ample rainfall the canal needs little help from the Sirsa Branch. In years of scanty rainfall or of drought, the supply is provided from the Sirsa Branch for short periods at longer or shorter intervals. On the other hand, in years of excessive rainfall such as 1900, the supply passing down this canal is excessive, sweeping over the banks in a deep wide strong flood.

The Sarauti Canal.—This canal was constructed in 1886 and extensions were made in 1893 and 1899. The supply is derived from the overflow of the Sanaa Jhil, near Pehow, which in its turn receives the flood waters of the Sarauti and Markanda, both hill torrents rising in the Sewalik in the Umballa district.

Distributaries have been constructed and outlets built. The outlets were first put in temporarily; they have now been built permanently. The water is conveyed to the land by flow in the usual way, being distributed through water-courses.

The supply is usually maintained from July to October sometimes the canal flows in June and late into November. Occasionally also it flows in the spring.

The following table will be found to give all known information regarding the volume and duration of supply:—

Year.	1877	1878	1879	1900
Number of days in flow	121	230	73	132
Number of days discharge over 100 cusecs	105	117	49	125
" " " " " 200 " "	51	51	13	63
" " " " " 300 " "	10	12	4	62
" " " " " 400 " "	3	—	—	62
Number of times over 1,000 cusecs	1	—	—	3

Note.—The leaves for 1891 have not come in.

The full designed capacity of this canal is 460 cusecs. Judging from the record of 4 years, the canal gets half supply for about 2 months, is in flow for about 4 months and when it gets full supply, it overflows and is braced in several places. This points to the necessity of regulating the flow of the torrents that supply the canal. In a flood year like 1900 it was estimated that the discharge of the Markanda at the Delhi-Umballa-Kalka railway crossing was something like 40,000 cusecs and that of the Sarauti at its crossing on the same railway, something like 35,000 cusecs. Under these conditions it is difficult to see how a canal like the Sarauti could escape damage.

D.—Canals of continuous flow.

13. (1) The ordinary rain crops (*barani*) in the *Kharif* are coarse rice (*satli* or 60 day), bajra, jowar, kharra and cotton, and in the *rabi*, gram, jaw, sarson and belia (mixed gram and barley). With the introduction of irrigation these crops have given place to the following products; in the *Kharif*, dhani (fine rice, ziri) chahi, cotton, indigo, sugarcane, vegetables, tobacco, maize and gardens, and in the *rabi*, wheat, barley, gram, sarson, mothi and masri. Now the value of a *barani* crop, taken all round, does not rise to over, say, Rs. 12 per acre on the average ranging from Rs. 8 an acre for bajra to, say, Rs. 18 per acre for coarse rice. By growing two irrigated crops the value per acre might easily be raised to Rs. 50 or about 425 per cent.; for, rice at Rs. 40 may be followed by gram at Rs. 20 an acre, or chahi or bajra at Rs. 15 may be followed by wheat at Rs. 35 an acre, or again cotton at Rs. 35 may be followed by mixed grain or barley at Rs. 23 an acre.

13. (2) Taking the above estimate of the average value of a *barani* crop at Rs. 12 per acre, the increase in value of the produce by irrigation might be raised from 600 to 1,000 per cent. by substituting more for less valuable crops. Gardens are estimated to be worth Rs. 100 an acre and sugarcane is valued at Rs. 120 an acre on the Western Jumna Canal.

13. (3) (a) In a year of ample rainfall I take it that the *barani* crop would value about Rs. 12 an acre, and that the increase in yield of irrigated crops would not be above the average, which is about 300 per cent. for a single crop; the value of the irrigated crops being, say, Rs. 35 an acre.

(b) In a year of scanty rainfall the *barani* crop would fall in value to an 8-anna crop or, say, Rs. 6 an acre. The irrigated crop would also suffer to some extent, say, 10 or 15 per cent., and the value would drop from, say, Rs. 35 an acre to Rs. 30 an acre. The result would be that the irrigated crop in a year of scanty rainfall would be 600 per cent. better than the *barani* crop.

(c) In a year of drought there would be no *barani* crop and the irrigated crop would diminish in yield, though not perhaps in value, as prices rise in years of drought. The increase due to irrigation would be the entire produce.

14. (1) If the supply commenced too late for the sowing period of any crop, there would be no irrigated crop at all. The effect of any delay in commencement of supply is to throw back the crop, and a long delay might possibly run it into the next crop. The sowing time of any crop may be divided into three unequal periods: first, the period of early sowing, producing an early crop not always the best; secondly, the period of full crop, producing the crops of best value; and lastly, the period of late sowing, producing scanty crops. If the commencement of the supply were delayed beyond the first period, there would be no early crops; the value of the remaining crops would not be affected; if the commencement of the supply were postponed to the end of the second period, there would be no early crop and no full crop; the area of crop would have shrunk considerably, but the value of the late crop would not have been affected thereby; if the commencement of supply were postponed to the end of the third period of normal years, there would be no crop at all.

The value of irrigation as a crop producing agent is proportional to the delay in commencement of supply, owing to the shrinkage of the possible area, but practically the value per acre of crop sown is unaffected by the late commencement of supply.

14. (2) The too early cessation of supply might mean the withering, more or less complete, of the crop. This is more serious than the too late commencement of the supply, as the loss of the sown crop includes the loss of grain sown and labour expended on sowing, etc. The value of irrigation is directly affected by the early cessation of the supply. The last sown crops would be first affected and, as the time of cessation approached the end of the sowing period, the full and early crops successively. The diminution of value would follow the following order—stunting of crops, shrinkage in yield of grain, loss of all grain, indifferent fodder, complete loss of fodder.

15. Ordinarily the irrigation of this canal is not supplemented by irrigation from wells. On canals of intermittent flow this is essential for maturing the *rabi* harvest sown on one watering. Irrigating by wells crops sown by irrigation from the canal has been done in a few cases on this canal, but the cases are so few and the area so small that the question has not attracted more than passing notice.

16. (1) I estimate that on the average in normal years on this canal the value of the produce per irrigated area is Rs. 40. My estimate is given below. I have taken the principal crops and have worked out the normal extent of cultivation of each kind of crop, and, having allotted normal rates for each kind of crop, I have ascertained the average value of production per acre.

Crop.	Area per cent. grown.	Rate per acre.	Value.
	Aores.	Rs.	Rs.
Wheat	42.0	31	1,428.0
Sugarcane	11.3	120	1,356.0
Cotton	11.0	33	363.0
Gram	6.5	20	130.0
Rice	5.0	42	210.0

Crop.	Area per cent. grown.	Rate per acre.	Value.
	Aores.	Rs.	Rs.
Barley	2.8	24	67.2
Indigo	1.1	60	66.0
Sarson	0.6	18	10.8
Masur	0.6	15	9.0
Gardens	0.3	100	30.0
Miscellaneous	18.8	18	338.4
TOTAL	100.0	...	4,008.4

Rs.

Average rate per acre 40

I estimate the value of *barani* crops to be on the average Rs. 12 per acre in this district. The estimate below has been prepared in the following manner. The percentage area of the chief *barani* crops has been obtained from settlement reports of this district, and are offered as representing normal conditions; the rates per acre have been estimated from the produce estimate of the settlement reports and from the prices of normal years.

Crop.	Area per cent. grown.	Rate per acre.	Value.
	Aores.	Rs.	Rs.
Cotton	4.0	16	60.0
Rice (coarse)	23.0	18	414.0
Juar	24.0	9	216.0
Bajra	3.0	8	24.0
Gram	40.0	10	400.0
Sarson	1.0	10	10.0
Mixed	5.0	14	70.0
TOTAL	100.0	...	1,194.0

Rs.

Average rate per acre 12

The increase in the total annual value of the produce per acre due to the irrigation in normal years is $(40-12)=$ Rs. 28 according to the above estimate.

16. (2) I estimate that in a year of drought the average value of produce per acre irrigated is Rs. 58-8. From the revenue report of the Punjab Irrigation Department for 1897-98, I have taken the percentage areas of crops grown. In the rates for each kind of crop, I have combined the rise of prices exhibited in the Karnal district census report of 1901 with an estimate of reduction of output, and have arrived at certain figures given in the following table:—

Crop.	Area per cent. grown.	Rate per acre.	Value.
	Aores.	Rs.	Rs.
Wheat	30.0	36	1,080.0
Sugarcane	9.0	100	900.0
Cotton	20.0	33	660.0
Gram	5.0	25	125.0
Rice	5.0	40	200.0
Barley	1.7	25	42.5
Indigo	5.0	60	300.0
Sarson	0.7	20	14.0
Masur	0.5	16	8.0
Gardens	0.3	100	30.0
Miscellaneous	20.8	20	416.0
TOTAL	100.0	...	3,855.5

Rs. As.

Average rate per acre 38 8

In a year of drought the *barani* crop may fall to nil, but suppose it is a Rs. 0-4-0 crop, the value per acre would, be $(\frac{1}{2}) =$ Rs. 4.

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Hence the increase in the total annual value of the produce per acre due to irrigation in a year of drought is (38-8-4)=Rs. 34-8 according to the above estimate.

It is difficult to arrive at any but approximate figures, for in a year of severe drought there may be a considerable amount of unrecognized "*Kharaba*" or short produce, while at the same time the prices may not rise in the same proportion. "*Kharaba*" may be more or less local while prices vary with the produce of the world and the distance from markets.

17. (1) The cultivator pays to Government for irrigation from the Western Jumna Canal on the average a water rate of Rs. 2-8, which is about Rs. 3-6 in the *kharif* and Rs. 2-3 in the *rabi*. This is paid on the actual area irrigated.

17. (2) The cultivator pays to the owner of the land either $\frac{1}{4}$ th to $\frac{1}{3}$ rd the produce as a *batai* rate or for irrigated land from Rs. 4-6 to Rs. 9-2 per acre. The more usual rates are $\frac{1}{4}$ th of produce, or Rs. 4-6 per acre. The cash rates are just double of what is paid for *tarami* land. The enhanced rents for irrigated land are paid for the area actually irrigated, as a rule. Some owners, however, make no difference if the land is irrigated or not during the year. This occurs rarely.

17. (3) The cultivator pays to Government the owners' rate, which amounts to about Rs. 1-2 for both crops, or for the *kharif* Rs. 1-5 and *rabi* Rs. 1-0 per acre on the average. This rate is paid on the area actually irrigated. In addition to the occupiers' rate and owners' rate, the cultivator also pays the local cesses known as *sacai*, which is about Rs. 0-20 per acre on the average paid on the area actually irrigated.

17. (4) There are no private canals in this district, the owners of which pay royalty to Government.

18. The cost of constructing the watercourse with all bridges, etc., and bringing the water to the field is borne by the landlord, and amounts in the first instance to Rs. 0-8-0 per acre on the average. The cost of preparing the land for irrigation is borne by the tenant. Thus in the case of jungle land to be broken up for the first time, the tenant cuts down the trees, jungle, etc., and keeps all this in lieu of cost and trouble taken to clear the land. On the other hand, the tenant gives $\frac{1}{3}$ rd in place of $\frac{1}{4}$ th of the produce owing, it is said, to the higher productive value of virgin soil. It is difficult to say what the average cost of preparing the land for irrigation amounts to. The tenant chiefly puts his own labour into it.

19. Regarding the evils that sprang from excessive irrigation and the damage that resulted to the people and the soil of this district in the old days of this canal, I would invite attention to paragraphs 159 to 170 of Mr. Ibbetson's report on the settlement of the Karnal district. Since then the canal has been re-aligned below Indri, distributaries have been re-aligned, various extensions have reduced the supply going to the older water-logged tracts, the distributaries have been remodelled with a view to diminish concentrated irrigation, and drainages have been opened up. The general result is that the condition of the people and soil has been gradually improving. An independent proof of the improving condition of the water-logged tracts will be found in the fact that mauza Phurlak, which refused to have any canal water 20 years ago, has since 1898 asked for and received a limited supply of canal water. Phurlak is one of the villages given in page 774 of Mr. Ibbetson's report referred to above. There are still some tracts in mauzas Dadiana, Baholi, and Sitano, where from salt efflorescence the land has been completely thrown out of cultivation. In my opinion, nothing can be done for these tracts. Elsewhere, by the re-alignment of the canal and by the opening up of the drains, the old evils are now gradually diminishing. In more recent times (since 1893) other parts of the district have become water-logged from percolation and arrested drainage. After the Sirsa Branch was opened, the canal supply was raised from the Head of Tajnwah (Amballa district) to Indri. Later on the Sirsa Branch began to silt up, and the supply in the main canal above Indri was gradually raised in order to supply the Sirsa Branch. This resulted in water-logging in the Khodri to east of the canal. Khodri drains were opened out in 1896, and the result has been most satisfactory. Along the right bank of the canal between the Bangor Dhand and the canal, swamping resulted from raising the canal supply for the Sirsa Branch. The remedy applied has been to silt up the swamps and raise the surface of the ground up to canal full supply. A good deal has already been done in this way, a lot remains to be done, the process is in progress and not yet completed. Another remedy has been to cut off the *bands* in the old serpentine course of the

canal and thus reduce the water surface levels above the loops out off. This remedy does not appear to me to be of permanent value. The fall in water surface in the main canal is very severe, ranging from 7-500 near Dadpur to 2000 near Indri. The soil through which the canal passes is sandy. When a loop is cut off, the effect is to lower the water surface above the out-off. This increases the water surface slope and also tends to increase the erosion of the canal bed and banks. The natural tendency of the canal with such severe slopes is to flatten its surface slope by lengthening its channel, and cutting off a loop in one place causes the canal to gradually cut out a loop for itself somewhere else. This is what is actually taking place. The action is slow but sure. The best remedy is to silt up the low ground and raise it above the level at which it remains a permanent swamp. The best remedy of all would be to re-align the main canal from Dadpur to Indri. The effect of this would be a permanent remedy of all swamping, water-logging, and disease. This question is certainly one that needs consideration and especially if it is deemed desirable to augment the *kharif* supply of this canal or found possible to increase the winter supply by restricting the supply to the Eastern Jumna Canal during the period of low river. The loss by absorption in the main canal is considerable, and much of this might be saved by a high level canal in better soil than the present sandy tract in which the canal runs.

According to the remodelling of the distributaries, the high and dry tracts of the Bangor and Nardak have been allotted a supply equal to irrigating 30 per cent. of the gross commanded area. This is as high a percentage as might well be allowed as long as manure is not used by the agriculturist. On the other hand, the supply allotted to the old irrigation by remodelling has been fixed at 45 to 60 per cent. of the commanded area. This is a reduction on the actual irrigated percentage. There is no doubt that a certain amount of restriction in the supply in the *rabi* should be effected in the *Khadir* villages, as even the supply, as limited under the remodelling system, will in time produce swampy conditions.

My experience of draining irrigated lands goes to show that the drains are most beneficial. I have seen the drains in this district in what might be called a succession of dry years; how the drains would act in a succession of wet years I cannot from experience say. They are at present very effective, and this year all the *jhils* and swamps have been run dry by our drains. The drains must reduce swamping in any year, though not so effectually as they have done this year.

20. The maintenance of the canal and distributaries of the Western Jumna Canal is paid for by Government. The work is done by contract. In some cases the cultivators and owners have assisted Government in the rapid clearance of silt, but all work so done has been paid for by Government at the usual rates current in the division for such work.

The maintenance of watercourses is effected by the cultivator. The custom of the district is for the owner to stand all expenses of bringing the water to the field; the subsequent labour of keeping the channel clear of silt, repairing the banks, etc., for the year or crop devolves on the cultivator. When a tenant fails to assist in the necessary clearance, the owner pays a fine of 4 annas in behalf of the tenant and recovers the amount by a grain equivalent when the crop is cut. There is a good deal of 'give and take' in the current custom of the people, and a good deal of consideration is shown, when for good reasons, sickness, etc., the tenant is unable to assist in the silt clearance. The system works well, and no legislation is at present needed. I do not remember a single complaint against the arrangements made by the people, and I think that a system which the people work so well requires no assistance from us.

21. The only private canal in the district is the Saranti, and it is not one of continuous flow. The canal was constructed and is worked and maintained by the District Board. The only trouble that has arisen from the construction of this canal is a claim set up by the Patiala State that certain villages have thereby been deprived of flood water from the Saranti stream. Government have not taken over the management of this canal.

22. There is the Markanda canal project, which the District Board was once anxious to take up. The effect of the Saranti Canal and the results of its working are fairly well known now. The conditions of the Markanda project would be about the same. The construction might be considered. The District Board would require professional advice, and this might be given by Government free.

Statement giving particulars of wells in the Karnal district.

Mr. R.
Egerton.
Presides.

TRACT.	Sub-tract.	Average depth of spring water level in wells.	NATURE OF SUPPLY SPRINGS OR PERCOLATION.		Average cost of construction.	Average duration or life of well.	Manner in which water is usually lifted.	Average area attached to or commanded by a well.	Average area irrigated in one year.	REMARKS.
			In ordinary years.	In dry years.						
		Feet.			Rs.	Years.		Acres.	Acres.	
KHADIR	Indri	5 to 15	Chiefly percolation.	Chiefly percolation.	300	75	Persian wheel and bucket.	30 to 40	15 to 20	This statement has been compiled from the register of well measurements in this division, from special enquiries, from settlement reports, and from personal knowledge. On the plan of the district accompanying this, note will be found marked the villages, the wells of which have been selected for inclusion in this statement.
	Karnal	12 to 20			300					
	Panipat	15 to 25			350					
NAILI	Thanesar	20 to 30	Springs	Springs	350	100	Wheel and bucket.	10 to 15	8	
	Kaithal	30 to 50			400			10 to 15	0	
NARDAK	Karnal	30 to 50	Springs	Springs	450	100	Bucket	10 to 15	8 to 10	
	Kaithal	60 to 115			600	200		Nil	...	
BANGAR	Indri	20 to 25			400	100		10 to 15	8 to 10	
	Kaithal	120 to 160	Springs and percolation.	Chiefly springs.	1,000	200		Nil	...	
	Panipat	30 to 60			500	75		8 to 10	5	

34. (1) In the foregoing statement I have given the average depth of spring level in permanent wells. The depth of water varies from 20 to 30 feet in the wells, as the wells, to be permanent, have to go down to the 'bum' or spring level obtained in blue sand. The depths increase as one goes westward from the river Jumna.

(2) There is no marked tendency for the wells to run dry. The wells are more or less saline in Kaithal, Nardak, and Bangar. The Khadir wells and also the wells along the old canal lines are fed by percolation.

(3) The cost of construction given in the foregoing statement is for wells worked by a single bucket or wheel, which are from 7 to 8 feet in diameter. Wells from 11 to 12 feet in diameter cost proportionally more.

(4) It is difficult to fix the average life or duration of a well. Sometimes a well gives out or falls in in a few years, others go on for generations. Some old wells, 300 or 400 years old, are still to be seen in good condition. In one or two instances wells from inferior mortar or faulty construction have failed in a few years.

(5) The Persian wheel is used in the Khadir and parts of the Thanesar Naili, but generally throughout the district the bucket or *charas* is used.

(6) Some of the wells to depths of 60 or 70 feet are worked occasionally, but generally irrigation from wells is confined to depths up to 50 feet. In Bangar and Nardak the areas attached to wells are small.

(7) I am informed that the wells about Karnal irrigate about 20 acres annually. In the Karnal Nardak I am told that the area is about half this. I know that the area is still less in some places.

35. I have no figures to assist me in estimating the extent of increase in value of produce from well irrigation. The supply of water from a well is not so plentiful as canal water usually is. Two crops can and are grown, chiefly when the water is within 30 feet of the surface. Rice is not grown from well water, but all other crops are. High class cultivation, viz., garden vegetables and engareans, greatly increases the value of this class of irrigation.

In years of ample rainfall the value of well-irrigated crops is in every way equal to canal-irrigated crops. In dry years the crops lose in value, first, in diminished fodder and lighter gram, then in loss of gram and finally in loss of fodder even, as the drought continues and the cattle die off. This only occurs in severe famines. In dry years the difficulty is to keep the cattle alive or even up to the mark.

36. (1) I have no figures of the exact areas of well-irrigated crops. In a normal term of year I should say that the average value per acre of this kind of cultivation

is about 90 per cent. of canal irrigated crops. I have elsewhere above estimated the value of canal-irrigated crop at Rs. 40 an acre on the average. Hence well-irrigated crops would be Rs. 36 an acre. As the average value of *barani* crops has been estimated at Rs. 12 an acre, the approximate increase in the total annual value of the produce per acre due to well irrigation would be Rs. (36-12)=Rs. 24 in normal years.

(2) In a year of drought there may be no well-irrigated crops. But assuming that the well-irrigated crop drops to a 12-anna crop while the *barani* crops drop to a 4-anna crop, the increase in the total annual value of the produce per acre in years of drought due to well irrigation would be $(36 \times \frac{1}{4}) - (12 \times \frac{1}{4}) = 27 - 3 = \text{Rs. } 24$, or the same as in ordinary years.

37. (1) The cultivator works the well, and for the use of well and land pays to the owner the same rate as for canal land, viz., 1th to 1rd *batai* or from Rs. 4-6 to Rs. 9-2 per acre. This payment is on the actual area cultivated.

(2) The owner pays Government an enhancement of revenue for well-irrigated land at the rate of Rs. 1-8 per acre on the full area commanded by and attached to the well.

38. (1) No serious difficulties are encountered in finding a supply of water. In the uplands the water is more or less saline.

(2) Besides the usual difficulties of well-sinking, there is one difficulty of construction peculiar to the locality. In Khadir and along the old canal wells have to be sunk through one or two layers of percolation water until they top the *bum* or spring. Near Karnal very frequently the well strikes in clay after having passed the first percolation layer. This renders well sinking very costly. I am not aware that any assistance has been offered in the shape of expert advice, trial borings, or the loan of boring tools. Where wells are needed for cultivation, they are so near one another that expert advice is not needed. As a matter of fact, very frequently the local well-sinker knows more than the professional Civil Engineer. We tried to sink a well in the Mundri compound on the Siresa Branch. We had to abandon it, as our establishment had got it too crooked and cracked to get right. About two years ago I called in the local well-sinker, and he undertook to dig up the abandoned well, dig a hole right down to water surface, and begin the well from there. He did it. Fortunately there was no intermediate percolation layer; but he did what Government engineers had given up. I do not think we can generally go in for advising in this matter. If we trained an officer and gave him opportunities of acquiring experience in well-sinking, then Government might step in and give advice. Unless we had sound advice to offer,

Mr. R.
Egerton
Purves.

we should bring discredit on ourselves. The man who has to pay for the well will not be happy if things go wrong, and it certainly will be no consolation to him to know that an engineer otherwise eminent in his profession had given him advice. Rightly or wrongly, the engineer would be blamed.

39. I am not in favour of the construction by Government of wells in land which is private property. It is not the well that produces crops, but the working of the well. After making the well, how are we to ensure its being worked? There is an old proverb that one man may bring a horse to the water, but a thousand cannot make him drink. I am not prepared to say that the people would be stubborn, but what I wish to say is that we have not the power to have the wells worked. Self-interest, if it existed, would induce the owner to sink his own well. The custom of the district is for the cultivator to find the bullocks, the owner may help him with money occasionally, but it is the tenant who runs all the risk. Is the tenant in this district strong enough to work wells over and above the present number? I doubt it. If Government constructed wells free of cost, it would probably help the

people, but then the owner, the wealthy man, would come in for a share of gratuitous aid. He does not need this help. We might encourage and stimulate the demand for wells by lighter assessments on new wells in unprotected areas and even grant loans freely on reduced interest and no interest at all; but the actual construction of a well by Government should not be undertaken without the express request of the owner.

40. Temporary wells are used in the Khadir and part of the Naili tracts. In some villages the sub-soil is too loose to admit of temporary wells being sunk, and at best they only last for one crop, very often failing when most required. In a year of drought I should give free grants or the cost of digging, after the well had been sunk, and not charge the wet rate for well irrigation. Temporary wells cost about Rs. 10. Like all well irrigation, temporary wells require bullocks to draw the water. In years of drought the bullocks, like the policemen, are absent when wanted. In dry years, too, the supply of water is deficient and sometimes absent. As a protection against drought, temporary wells are not very encouraging.

(28) Mr. J. J. MUZZLEY, M.I.C.E., Superintending Engineer, Western Jomna Canal Circle.

Mr. J. J.
Mullaly,
M.I.C.E.

I. Preliminary. Previous state of country.—The country dependant on the older portions of the Western Jomna Canal has always suffered from water-logging.

The extent to which this evil prevailed in the early days of the canal need not now be described: a reference to the District Gazetteers noted on morgia will suffice.

II. Work already done. More required.—Since then the canal and its distributaries have been re-aligned and numerous drains dug, and lately the outlets have been remodelled. All this work has greatly improved the state of affairs, but still more needs to be done.

III. Description of papers and plans now submitted.—I put up a map* of certain parts of the Karnal and Delhi districts, which shows the depth of the sub-soil water table below the surface of the ground. I also put up a statement (Appendix A) showing the percentage of the culturable commanded area which is irrigable and has been irrigated, and I also attach a statement (Appendix B) showing the rainfall over the water-logged tracts in the early and later rabi.

IV. Plan shows the depth below ground surface of the subsoil water table.—Turning first to the map,* I have shown on it by contours the areas in which the depth below surface of ground of the sub-soil water is 10, 15, 20, and 25 feet, and it will be seen that in almost the whole of the area served by the main canal and the Delhi Branch the sub-soil water is within 15 feet of the ground surface, whilst in large areas in the Jagadhri, Karnal, Panipat, and Sonapat Tehsils the sub-soil water is within 10 feet of the ground surface.

V. Appendix A shows that very little well irrigation is done.—The table in Appendix A shows that, although the water surface in wells is so near the ground surface, yet out of a total of 635,085 acres commanded in the four tehsils concerned in the Karnal and Delhi districts, only 22,121 acres or 3.2 per cent. is well irrigated, whilst in the Sonapat and Delhi tehsils, if we deduct the unculturable land, we find that out of 207,800 acres of culturable land commanded by the canal, only 5,842 acres or 2.8 per cent. is irrigated by wells. I do not work out the similar percentage for the Karnal and Panipat tehsils, because I do not think it possible that nearly half the commanded area in Karnal and nearly one-third of it in Panipat can be unculturable as shown in the settlement statistics. I, however, compare the proportion of well land to total commanded area in these two tehsils with the similar proportions for Delhi and Sonapat tehsils, and I find that the proportion is about twice as great, and I therefore feel sure that I am right in saying that the percentage of well irrigation in culturable commanded area is in the Karnal and Panipat tehsils about 6 per cent., and in the Sonapat and Delhi tehsils 2.8 per cent.

This is an extraordinary state of affairs, and shows how completely the cultivators have abandoned all other means of irrigation for canal water.

VI. The true remedy.—All the water we pour into this tract is allowed to remain, soaking the soil and gradually raising the subsoil water plane, whereas the true remedy is to stop the supply of certain seasons of the year and to draw up some of the surplus spring water by well-irrigation.

VII. But this table further shows that the percentage of commanded culturable area (column C) which has been irrigated as an average in the 3 years ending 1890-1900 is—

In the Karnal tehsil	35 per cent.
" " Panipat "	46 " "
" " Delhi "	47 " "
" " Sonapat "	40 " "

whilst in some years this percentage rises to 38, 49, 60, and 42 in the respective tehsils.

If these are the percentages for whole tehsils, the village percentage must be anything from 75 to 100, and it is abundantly evident that the whole of this tract is greatly over-irrigated.

VIII. Summary of present conditions and the remedy proposed.—I find then that, in the areas coloured green in the map,* the subsoil water is so near the ground surface as to be a source, in many localities, of unhealthiness, that the tract is greatly over-irrigated with canal water, and that the villagers have completely neglected the only rational remedy for water-logging, viz., well irrigation. I therefore propose to cut off the rabi supply except for one watering before sowing, as has been done in similar tracts on the Bari Doab, Sirhind, and Chenab Canals.

IX. The proposals are feasible.—To show that this is perfectly feasible, let us compare the Western Jomna tract with the tract on the Sirhind Canal, which has only lately been treated in this way.

X. Rainfall of the similar tract on the Sirhind Canal.—The Sirhind Canal area lies round the rainfall stations of Bul and Akhara, and the average rainfall at these stations up to the end of 1898-99 (the latest figures I have got) is—

At Bul early rabi	0.77	} Average of 5 years.
" " late "	2.78	
At Akhara early rabi	0.74	} Average of 15 years.
" " late "	2.69	

Now I put up a statement (Appendix B) showing the rainfall of all the Western Jomna Canal stations in the area under consideration, from which it will be seen that the average rainfall here is—

In the early rabi	0.97
" " late "	2.28

so that the conditions as to rainfall are almost identical, whilst the depth of subsoil water in the Sirhind tract is, I believe, from 10 to 25 feet, whereas in the Western Jomna tract it is from 8 to 15 feet only; so that there is no reason why the rule which has done so much good on other canals should not work equally well here.

special supply for this potty distributary in the bed of such a large obannel as the Delhi Branch, without enormous wastage, and we shall have therefore to close this distributary also in the *rabi*, but I think it would be fair to add 50 per cent. to the capacities of all the outlets in the Bohra, Pui, and Jaunti branches of this distributary, so that the areas lying outside of the 15 feet contour might be amply compensated for the withdrawal of *rabi* supplies.

Mr. J. J.
Mullaly,
M.I.C.E.

In this way the whole of the Delbi Branch can be closed after giving one watering for the sowings of the rabi crops and for the maturing of the sugarcane crops.

(c) *Date from which the changes should take effect.*—Should my proposals be accepted, we shall further have to consider from what date this change should take effect.

It will be urged that the villagers will require time to accustom themselves to the new conditions. This is true, and I would in addition draw special attention to the paucity of wells. There are large areas under gardens throughout this tract which will require wells as a stand-by. It must, however, be remembered, on the other hand, that the wells will be very shallow; each well could be built easily in a month; so that time is not such an important element as the money to make them with. Government, however, are prepared, I understand, to assist zamindars with advances, and I feel sure that were those changes sanctioned by Government, the district officers would see that those requiring temporary assistance got it.

After taking into consideration the less depth of the sub-sill water table and the greater percentage of wells already existing in the upper reaches of the canal, I suggest that the distributaries taking out above Munak and supplying the upper parts of the water-logged tract might be gazetted as special class distributaries from the 1st October 1902, and those which supply the lower parts of the water-logged tract from the Delhi Branch might be so gazetted from the 1st October 1903.

XIV. Water thus saved will be a great boon to very dry tracts now frequently stricken with famine.—There is one more aspect of this case that I must touch upon.

The list in appendix C gives the names of the distributaries that will be closed during the *rabi* after giving one watering for *rabi* sowings, if these proposals be accepted, and from it we see that 1,300 cusecs of water will be liberated in the *rabi* season for use in the dry tracts of Hissar, Rohtak, and possibly in Gurgaon.

Taking the moderate duty of 120 acres per onseo, this would enable us to irrigate 156,000 acres of new land and to protect from famine $4 \times 156,000 = 624,000$ acres or, say, 1,000 square miles of new country.

When I add that the tracts which would receive this supply are those most liable to famine of any in the Panjab, and that, as there is plenty of spare water in the river for *kharif* crops, these tracts would have a perennial supply, and I think I have shown that the measures advocated in this report will not only benefit the super-saturated areas on the older parts of the canal, but will be of the greatest help in keeping famine from the districts of Hissar, Rohtak, and perhaps parts of Gurgaon also.

* First for sowings between 1st April and 15th May; 2nd watering between 15th May and 15th June; 3rd watering between 15th June and 15th August; 4th watering between 15th August and 1st October; 5th watering between 15th October and 1st December.

APPENDIX A.

[illegible]

Statement showing rainfall from 1891-92 for rabi crop of each year.

[illegible]

APPENDIX C.

Source of Supply.	Authorized full supply as remodelled.	Totals by Branch.
	cusecs.	cusecs.
Main line outlets	13	13
<i>N.B.</i> —Total discharge is 20 cusecs, but of this 1rd will go to the Eastern Juwana Canal.		
Now main line.		
Budha-Khora Dis-tributary. }	28	
Depôt, minor . }	10	
Karnal Distribu-tary. }	14	
Bazida	107	
Rer Distributary. }	9	
Joshi " . }	16	
		182

APPENDIX C—contd.

Mr. J. J.
Mullaly,
M. I. C. E.

Source of Supply.	Authorized full supply as remodelled.	Totals by Branch.
	cusecs.	cusecs.
DELHI BRANCH.		
Madhanda Distributary	72	
Gahana "	169	
Israna "	160	
Naraina "	37	
Hulana "	78	
Bhainswal "	87	
Jua "	120	
Sonepat "	31	
Pai "	149	
Kakroi "	13	
Lampar "	20	
Bowana "	119	
Gangatoli "	46	
Siraprar "	41	
Sanant "	4	
		1,186
GRAND TOTAL . . . . .	...	1,331 say
		1,300 cusecs

(29) Copy of a letter No. 260-G.D., dated 18th October 1901, from S. Ashgar Ali, Esq., B.A., Deputy Commissioner, Hissar, to T. Gordon Walker, Esq., C.S., Commissioner and Superintendent, Delhi Division.

Famine Protective Works constructed during the last two famines in the Hissar district.

With reference to your circular No. 242, dated 16th September 1901, on the above subject, I have the honour to state as follows.

2. During the famine of 1896-97 small village tanks, 589 in number, were excavated in all parts of the district. Most of these tanks hold water sufficient to meet the requirements of the villages concerned for a year and some for six months.

Such village tanks have been found by experience to be very useful, both for men and cattle, and the people were satisfied with this form of relief.

As other larger works of public or permanent utility were not available, therefore the project of digging out large tanks of a size of not less than 1,200—600 on the borders of three or four villages was devised, so as to be of common use to them all, and 22 tanks of this kind were dug out in the various parts of the district.

These tanks have not proved so useful as they were thought to be. Some of them are stated to be defective in soil, and water is absorbed rapidly even if a large quantity were received in them. It sometimes happens, however, that after a few years the soil gets hardened and the water is no longer absorbed. In some of them rainy water does not come in so plentifully from outside as was expected at the time of selecting the sites. There are very few tanks which are expected to receive large quantity of water and can hold it for a long time. Such tanks can, no doubt, be very useful both for men and cattle, if large supply of water is received in them, and it may last for a long time, but for reasons stated above, as well as on account of scanty share of rain which this district generally receives, I am inclined to think that such tanks cannot be so useful as they are expected to be. It may be noted that these large tanks can only be used for supplying water to men and cattle, but they cannot serve the purpose of irrigation.

An extract from the Revenue Assistant's report is submitted herewith for reference.*

(30) Copy of a letter No. 62-G., dated 1st April 1902, from J. P. Thompson, Esq., Deputy Commissioner, Rohtak district, to T. Gordon Walker, Esq., Commissioner and Superintendent, Delhi Division.

In reference to correspondence forwarded with your circular endorsement No. 242, dated 16th September 1901, I have the honour to forward copy of a note compiled by Mr. Boyd, Assistant Commissioner, from the reports of various officials on the subject of the central tanks dug by famine labour in this district.

Copy of notes on tanks dug by famine labour in the Rohtak district.

The tanks thus constructed are:—

Mokhra	} Rohtak Tehsil.
Pir Bahand Din	
Dubaldhan	
Bhaproda	} Sampla "
Bhurwas	
Chhuahukwas	} Jhajjar "

With regard to the first question—

I. Have the tanks of impounding reservoirs held water to any reasonable extent?

The answer must be negative. In the rainy season of 1900 Chhuahukwas tank was filled to overflowing.

With regard to the other tanks, information is not forthcoming.

In 1901 the rains were scanty and not more than 2 of water was collected in any tank, while in three of them there was hardly any. No tank retained water for any time. Sand is nowhere in the district far from the surface. Consequently in the case of all the tanks the bottom is sandy and unretentive, but it is hoped that in time a layer of clay will form over the bottom. This has already happened partially in Dubaldhan, where the surrounding country is entirely composed of sand hills.

Further, except in the south of Jhajjar Tehsil, the village tanks are impermeable, and so there would seem to be reason for hoping that the large tanks will become so. The spoil banks also are largely composed of sand, and, to prevent injury to the bottoms by deterioration from the sides, kikar trees and *sarkanda* grass should be sown on the banks.

The Pir Bahand Din tank is further handicapped by its position, which deprives it of any fair supply of water unless from the canal, while the steepness of its banks prevents its being of much use for watering cattle. Unfortunately there is not room to flatten them out owing to the want of waste land around.

The Assistant Engineer deprecates any attempt to improve Dubaldhan by completing its excavation, as he considers it useless.

* Not printed.

Mr. J. P.
Thompson.

Q. II. What tanks have failed to hold water?

All; by the middle of September 1901 all the tanks were practically dry.

Q. III. What benefit, if any, has been realized by water so impounded?

Hitherto the tanks have been of no use.

Q. IV. What benefit is anticipated from the impounding of water?

If the tanks after a fair trial should prove retentive, two benefits may be looked for.

I. They will provide a supply of drinking water for cattle and in some places for men also.

This benefit will be more apparent in dry seasons, for the large tanks should contain water after the village tanks

have dried up, and thus many heads of cattle will be saved. The objection that they are too far distant from the villages is not a good one, for at present many villages are driving their cattle comparatively long distances to a tank where water is still to be found.

The water round the tanks will be sweetened.

In many villages in this district well and irrigation is only possible at the edge of the village tanks owing to the existence of nitre in the water. It is obvious that the larger tanks will effect a larger area, and so it may happen that well and irrigation will be greatly extended in the neighbourhood of these tanks.

Further, it is just possible that they may raise the water level around.

It is not expected that these tanks can be used directly for purposes of irrigation.

(31) Copy of a note by D. McGregor, Esq., District Engineer, Gurgaon.

Mr. D.
McGregor.

Commissioner's circular letter No. 242 was made over to me for a report after consulting the tehsildars. I also got a letter direct from Executive Engineer on this subject in

order to save delay. I sent my reply direct to that officer in the form of a statement on the 8th January 1902. I did not think any further reply was necessary.

(32) Copy of a note by Diwan Tek Chand, B.A., C.S., Deputy Commissioner, Gurgaon.

Diwan Tek
Chand,
B.A., C.S.

The above note of Mr. McGregor, to whom your letter No. 242 of 16th September was entrusted for report by Mr. Hamilton, shows that the necessary reply was sent by him direct to the Public Works Department in the form of a statement, a copy of which is attached herewith for your information.

I understand that there was only one tank dug during the last famine in this district, and that too did not store water for long. Most of the famine works in this district were bund projects.

I regret your letter was not brought to my notice till to-day, otherwise I would have submitted my reply long ago.

Statement giving brief particulars about the tanks constructed during the famine, 1899-1900, in the Delhi Provincial Division.

Serial No.	District.	Tehsil.	Name of tank.	DEPTH OF WATER IN TANKS.			HOW LONG WATER REMAINED IN TANKS.		SIZE OF TANK.			What benefit has been realized by impounding water in tanks.	What benefit is anticipated from the future impounding of water.	REMARKS.
				During July 1900.	During July 1901.	At present, i.e., in September 1901.	During 1899-1900.	During 1900-1901.	Length.	Breadth.	Depth.			
1	Gurgaon.	Rawal.	Jatnaua	11'	2'	NH.	14'	NH.	600'	600'	10-12 2	None up to the present.	None . .	There was about 4 feet of water in the portion of the new tank in September 1900 which dried up in about 2 months. There is water in the old portion of the tank which benefits the wells and is used for cattle drinking. During August 1901 seven feet of water came into the tank, but dried up in about four months. The benefit is much the same as at the end of 1900.

(33) KHAN BAHADUR MIRZA JIND VADE KHAN, WAZIR, BAHAWALPUR STATE.

Memorandum on the irrigation system of the Bahawalpur State.

Khan
Bahadur
Mirza Jind
Vade Khan.

The Bahawalpur State has an area of about 70 lakhs of acres, which is naturally divided into two main portions:—

(a) The tract lying along the bank of the Sutlej and the Indus is commonly termed "Sindh." It is fertile, and has an area of about 30 lakhs of acres.

(b) The tract lying between the "Sindh" and the border of the Bikaner and Jaisalmer States is called "Cholisthan." It has an area of about 40 lakhs of acres, and is in a waste condition, because cultivation in this part of land wholly depends upon rains, which are very scarce.

2. The means that exist for the irrigation of the "Sindh" tract are as under:—

(1) Inundation canals.

- (2) River floods.
- (3) Natural creeks.
- (4) Escapes.
- (5) Regulators and sandelas.
- (6) Wells.
- (7) Rains.

(1) Inundation canals.

3. The total number of major canals which take from the river is 36, their maximum length and breadth being 100 miles and 120 feet respectively. The branches that are drawn from the canals number 280 with the maximum length and breadth of 35 miles and 50 feet respectively. Besides these, there are numerous watercourses for conducting water into the lands, the longest of them being 12 miles

with a breadth of 10 feet. These canals, branches, and the watercourses cost the State and the zamindars the sum of about 10 lakhs of rupees every year on account of their excavation and clearance.

Till the year 1883-84 the number of the State canals was very small, for the river water which came in abundance irrigated by inundations tracts to a far off extent. But since that year when the Sirhind Canal was opened, followed by other perennial canals, serious decrease has taken place in the waters of the river on this side of the country falling heavily upon the prosperity of the Bahawalpur State. The people being reduced in means found themselves utterly unable to keep their lands under cultivation. On the appearance of this emergency, the State undertook the lowering of the beds of the existing canals and the constructing of new ones. These works, which have been strenuously carried on till now, have cost the State Treasury the sum of Rs. 18,84,334-3-4, besides numerous expenses incurred by the zamindars. It is to be noted that, in spite of all the efforts, the result has not been proportionate to the cost. The present annual average of the irrigation is 2,357,433 bighas, whereas before the opening of the Sirhind Canal when the number of the canals and branches was not so large as it is now the average was 1,432,930 bighas. The reason of this is obvious. The Government perennial canals take so much of the water that with the exception of inundation season, at all other times the Punjab rivers have only a nominal quantity of water in their beds. The deterioration effect produced by the Sirhind perennial canal on irrigation in the Bahawalpur State has been fully recorded in a report dated 14th October 1900, submitted to the Superintendent, Bahawalpur State, with this office No. 684 of 14th October 1900. (A copy of the report is attached herewith as Appendix A.)

All the inundation canals are owned by the State, and there is none constructed by the zamindars at their own cost.

The inundation canals in the State serve for the cultivation of *rabi* and *kharif* crops.

(2) River floods (swells).

4. The riverain lands receive their irrigation mainly from the river floods, which in the season of inundation run over large tracts. The floods, besides irrigating the soil, bring it another advantage by improving its quality in virtue of the silt strewn upon it. But on account of the decrease of river waters this natural source of advantage is daily lessening in capacity. Before the opening of the Sirhind Canal the average extent of the yearly area irrigated by river floods was 1,010,031 bighas, whereas the yearly average of the last five years is 648,623 bighas, which shows a fall of about one-third of the previous average, notwithstanding the fact that the means of irrigation has been greatly multiplied since 1883. As it is understood that a weir is to be constructed across the Butlej near Ferozepore, it may be apprehended that the riverain tracts of the State will be reduced to the verge of ruin. An instance of this already exists in the case of riverain lands of the Ravi river.

(3) Natural creeks.

5. For purposes of irrigation, the State takes advantage of a few natural creeks through which the water after running a certain length re-enters the river.

During the flood season dams (*bunds*) are raised in the beds of these creeks at proper situations. This measure helps in the cultivation of the *rabi* crops.

(4) Escapes.

6. For the irrigation of uplands near the bank of river and the heads of canal escapes have been constructed at the rivers, natural creeks and the canals with due consideration of the level of the land. These escapes supply water during the flood season and contribute towards the cultivation of the *rabi* crops.

(5) Regulators and Sandelas.

7. The decrease of river waters has gradually been followed by lowering of the canal water. The State has therefore constructed *pucra* regulators in the beds of the canals which facilitate the irrigation of the high lands. The distribution of water is conducted after the *warabandi* system, and a special establishment of *Muassifs* and *Mirabs* has been 10 Punjab.

organized for the purpose. The construction of the regulators has cost the State a heavy sum, and the work is still going on on a large scale.

There are large tracts of high lands, for the irrigation of which water is provided from canals by means of sandelas, which are a source of expense.

Khan
Bahadur
Mirza Jind
Pade Khan.

(6) Wells.

8. The number of wells in the Bahawalpur State is 10,070, of which 12,478 are in working order and the remaining 3,604 have fallen out of work. In late years the river water sufficed for the purposes of irrigation, and the zamindars constructed very few wells; but as owing to the construction of the Punjab perennial canals the rivers failed to supply the usual amount of water and, in spite of the construction of new canals in the State, irrigation was reduced to an unsatisfactory condition, the zamindars were instructed to sink wells, and various encouragements were held out to them. Takavi grants were freely made, the repayment being ruled to be made by instalments within twelve years. Besides this concession, the wells were exempted from *parta* or water-rate for 12 years, and the zamindars were allowed to take wood at half price. So that since the year 1879 the sum of Rs. 8,84,369-1-9 has been given out as takavi advance for new wells.

The depth of wells is generally 29 feet, while provisions to the opening of the Punjab perennial canals it was 19 feet. The wells on lands bordering the river are less deep.

In the season of drought some of the wells keep their water though at a lower level, some of them give water only for twelve hours instead of twenty-four, while some get quite dry.

The average cost per well in the State is Rs. 400.

The average area irrigated by wells lying on lands near the river, the tilling and sowing of which is done consequent upon floods, is 40 bighas. Similarly the average area irrigated by wells far from the river, the tilling and sowing of whose soil is done by utilizing canal water, is 30 bighas. But the wells which have neither the advantage of floods nor of the canals irrigate 15 bighas only. In years of drought the overage falls by one-third.

Note.—The average given above supposes the working of the wells continuously for twenty-four hours.

The number of wells that have fallen out of work is very large, and though there may be other reasons for which the zamindars are responsible, yet the chief reason is that before the opening of the Sirhind Canal all the wells were completed in consideration of the level of the springs at the time, and as the spring water has now gone down, most of the wells have failed to give water. The Ferozepore Weir which is in contemplation affords reasons for still greater apprehension, for the existing wells will also be rendered useless in consequence of it. The springs of these wells are fed by the river water. The soil of the State is loose, mixed with sand. The abundance of river water therefore quickly raises the springs, and a decrease in the former is speedily followed by a fall in the latter.

(7) Rains.

9. The State is almost a rainless country, and there is very little of *barani* cultivation done.

10. The "Cholistan," though forming a major portion of the State, is in a woe condition, as it is beyond the reach of river water. By occasional rains a little of *kharif* cultivation is done and a very small amount of revenue is realized on account of this and the *sajji* product. The revenue of the State entirely depends on the prosperity of the "Sindh" tract, and if a further decrease of river water takes place, this portion also will be reduced to the condition of "Cholistan," and the whole State will become a scene of desolation.

11. During the famine of 1897 the following relief works were opened:—

- (1) Excavation and clearance of canals.
- (2) Construction of wells.
- (3) Public Works.
- (4) Road-metalling.
- (5) Cutting of wood-foal.

The total amount provided for these works was Rs. 2,60,250-13-0. During the famine of 1899-1900 relief

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works were opened on a larger scale, and the amount provided therefor was Rs. 3,40,298-3-1.

12. In the "Sindh" portion of the State no necessity arises for constructing tanks, but in "Cholistan" such tanks serve to hold rain water. When there are no rains, drought prevails. This circumstance therefore shows that the constructing of tanks in "Cholistan" is also needless, for when there are no rains there is no water in the tanks and there is no fodder for the animals and no food for men. Another drawback is that, if wider and deeper tanks be undertaken, they could also be useless, for if water stands therein for a considerable period of time it breeds germs which, when taken in water, produce a disease called *Narva*. In times of famine emigrants from the Bikaner and Jaisalmer States come into Bahawalpur territory in very large numbers, for whom the State provides means for subsistence. The Darbar therefore thinks it advisable that some relief work, like the construction of a canal, be opened in "Cholistan." This will be useful in two ways: it will conduce to the prosperity of that tract, and will moreover afford the famine-stricken emigrants employment near their homes.

But for funds therefor the Darbar prays that the Supreme Government may be pleased to sanction a grant from the Indian People's Famine Trust.

13. The State finds no necessity for framing programmes of relief works beforehand, for the famine-stricken people generally appear in the cold season, and at that time the work of construction and clearance of canals and cutting of wood-fuel for the railway is undertaken every year; and besides these two fixed works, several other works are also set on foot for the occasion, which sufficiently provide for the large number of these people.

14. The facts recorded above clearly show that the decrease of river water has already seriously affected the prosperity of the State. If the contemplated weir is constructed near Ferozepore and a perennial canal drawn from the river, a very large portion of the population of the State will migrate to the British land, and this part of the State will be depopulated. The Jhelam Canal is to be shortly opened; this will take off most of the water formerly brought by the Jhelum into the Chenab. (See Council's Report, dated 31st January 1900, Appendix B.)

APPENDIX A.

No. 694, dated 14th October 1900.

From—The WAZIR of the Bahawalpur State, Bahawalpur,

To—Colonel L. J. H. GREY, C.S.I., Superintendent, Bahawalpur State, Simla.

With reference to your endorsement, dated 3rd September 1900, on the Director of Land Records' letter, dated 31st August 1900, I have the honour to submit herewith a report embodying particulars showing the deteriorating effect produced by the Sirhind Perennial Canal on irrigation in the Bahawalpur State, and to request for a due consideration being given to the interests of the State.

A report showing how far the prosperity of the Bahawalpur State riccraia territory has been injured by the construction of the Sirhind Perennial Canal.

I have very carefully gone through the correspondence received with the Director of Land Records, Panjab's letter dated 31st August 1900, and am now in a position to express my views on the subject under enquiry.

Mr. Maclean, Settlement Officer, Multan's note dated 3rd April 1900 contains statistics evidencing the deterioration of the Lower Sutlej Canal, due to the opening of the Sirhind Canal. The Honourable Mr. Wilson, in his letter No. 924, dated 14th May 1900, has enlarged upon the note of Mr. Maclean and stated that the injury pointed out therein is not confined to the Sirhind Canal, but can equally be alleged of all the perennial canals drawn from the various rivers of the Panjab. In the case of the Ravi it has been particularly marked, as in winter the lower bed of that river becomes wholly dry. Farther on he remarks as follows: "Already a weir is being constructed across the Jhelum and another is projected across the Indus, and it is probable that, as time goes on, other weirs will be constructed across the Panjab rivers at different points (there are already two across the Ravi, and a second across the Sutlej has been talked of), and that, at no distant date, almost every drop of water that flows in some of these river beds in the cold season will be diverted on to the uplands."

In view of these and other like considerations, the Honourable Mr. Wilson recommended that a general enquiry be instituted and the local officers of the British districts concerned be asked to furnish information showing how far (1) the area cultivated with the aid of river floods, (2) the area cultivated by means of inundation canals, (3) the area cultivated by means of wells near the river, have been affected by the opening of the perennial canals. He has also hinted at the desirability of taking some measures to obviate or remedy the injuries of which the inhabitants of the riverain villages complain, or to make some compensation for them.

Of course the question has its own importance with relation to the British districts, but with respect to the Bahawalpur State it is one of vital importance involving in the issues the best of its interests.

The injurious effects produced upon the prosperity of the State by the opening of the Sirhind Canal have keenly

been felt during the last several years. The fact has now and then been brought to the notice of the Government authorities. A few months ago, when the project of a weir across the Sutlej near Ferozepore was being commonly talked of, the Bahawalpur Darbar had in their report, dated 31st January 1900 (Appendix A), clearly pointed out the dangers which threatened the well-being of the State in case of the carrying out of the project. But now that the question of perennial canals has been formally raised and is subject to discussion, I take this opportunity of presenting the facts from the State point of view. The information to be supplied naturally falls under two heads:—

- (1) how far the prosperity of the Bahawalpur State has been affected by the opening of the Sirhind Canal and what efforts have been made and what expenses incurred to counteract its baneful consequences?
- (2) what calamity will threaten the State if a new weir is constructed across the Sutlej and a new canal opened?

PART I.—How far the prosperity of the Bahawalpur State has been affected by the Sirhind Canal.

2. The physical features of the Bahawalpur State, as represented on its map, show that its area is composed of two distinctly different tracts. The tract running along the Sutlej is called "Sindh," whereas the tract that is really an extension of the Rajputana desert and which extends alongside the "Sindh" tract is called "Cholistan," Sindh depends for its irrigation upon—

(a) Canals, (b) sailab or river floods, (c) wells.

Cholistan has only one means of irrigation—the rains.

Canals.

3. In the time of the old *Nawabs* of Bahawalpur the State possessed only a few canals, and even these were not constructed on any principle, with inevitable consequence of an ill-supply of water. Under these circumstances, the revenue of the State was of the most uncertain and inadequate nature. The real improvement of irrigation may be said to have begun in the time of the British Agency at Bahawalpur. During 1869 to 1879 canals were drawn from the river at almost all feasible points. When, on the accession of His Highness the late *Nawab* of Bahawalpur, Colonel L. J. H. Grey, C.S.I., then Political Agent, retired from the administration of the State in 1879, the system of irrigation had been placed on a satisfactory and useful footing. The improvements were, however, continued on the principles laid down by Colonel Grey. The State very generously provided many acres of rupees, and the *zemindars* also, who had by that time come to realize the advantages of canal irrigation, did not grudge expenses for the purpose. The consequence has been that there are at present 26 canals drawn from the Sutlej only, whose maximum breadth is 120 feet and length 100 miles. (See paragraph 6, Council's proceedings, dated 31st January 1900, attached as Appendix B.)

4. The operations for the construction of the Sirhind Canal began in the year 1874, and it was formally opened in the year 1883-84, and since that very year the effects of the decrease of water in the Lower Sutlej have been felt by the State.

5. Water gauge readings near the Adamwahm Bridge.

The average rise of the river as entered in the State records during five years previous to the opening of the canal was as under:—

	From April to September.	From October to March.
1878-79	5.08	1.23
1879-80	4.21	0.84
1880-81	3.79	1.15
1881-82	4.67	0.81
1882-83	3.85	0.78

The zero being at 868.5.

The average rise during the last five years, 1895-1900, was as follows:—

	From April to September.	From October to March.
1895-96	3.57	0.33
1896-97	3.27	0.43
1897-98	3.33	0.38
1898-99	2.01	1.31
1899-1900	1.67	1.86

The comparative decrease is shown by the subjoined table:—

		DECREASE.	
		FROM APRIL TO SEPTEMBER.	FROM OCTOBER TO MARCH.
1895-96 compared with	1878-79	1.51	1.56
"	1879-80	0.64	1.17
"	1880-81	0.22	1.48
"	1881-82	1.1	1.14
"	1882-83	0.31	1.11
1896-97	1878-79	1.81	1.71
"	1879-80	0.94	1.32
"	1880-81	0.52	1.63
"	1881-82	1.4	1.29
"	1882-83	0.53	1.26
1897-98	1878-79	1.55	1.61
"	1879-80	0.69	1.22
"	1880-81	0.26	1.53
"	1881-82	1.14	1.10
"	1882-83	0.32	1.16
1898-99	1878-79	3.07	2.54
"	1879-80	2.2	2.16
"	1880-81	1.78	2.46
"	1881-82	2.66	2.12
"	1882-83	1.66	2.09
1899-1900	1878-79	3.41	3.03
"	1879-80	2.54	2.7
"	1880-81	2.12	3.01
"	1881-82	3.0	2.67
"	1882-83	2.18	2.64

The above figures show clearly that there has been a gradual decrease of water in the Lower Sutlej since the opening of the Sirhind Canal, and that the decrease of each year has been greater than that of the previous one. (Vide Statement No. I.)

6. This continued decrease of water was very soon followed by its inevitable consequences; the canals failed to run at their proper capacity, the sowing of superior crops was retarded, even the inferior crops suffered for want of adequate supply of water, the *zemindars* began to desert their houses. To counteract these evils as best as it could, the State had to provide for new irrigation works, so that since 1863 the sum of Rs. 15,98,938-4-4 has been expended on new works, i.e., the excavation of canals, change of heads, construction of sluices, etc., as under:—

	Rs.	A. P.
Provided by the State as <i>imdad</i>	13,12,699	4 7
Advanced to the <i>zemindars</i> as <i>takavi</i>	2,56,239	15 9
TOTAL	15,68,938	4 4

See Statement No. II.

7. The fall of the river water necessitated the lowering of the canal beds so as to enable them to obtain reasonable water. This meant an immense addition to the expenses. The statement No. III shows the expenses borne by the *zemindars* on account of the construction of heads and clearance of canals during five years preceding 1883-84 amounting to Rs. 13,76,040-5-3, whereas since that year

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the amounts have risen very high as shown by the following figures:—

	Rs.	A. P.
1883-84—1887-88	17,27,671	5 9
1888-89—1892-93	27,10,681	1 11
1893-94—1897-98	34,13,577	14 7
1898-99—1899-1900	9,18,416	7 0

TOTAL . 87,70,346 18 3

The watercourses dug by the *zemindars* previous to 1883-84 cost them Rs. 80,484, those dug subsequently cost them Rs. 86,867-9-5. The total cost on all heads, including Rs. 86,867-9-5 during the last 17 years, was Rs. 88,56,714-9-8. The average cost for five years thus was Rs. 26,01,816-6-0, which shows an increase of Rs. 11,99,391-10-10 over the amount (including cost of watercourses) for the five years previous to the opening of the Sirhind Canal. This increase may be mainly attributed to the fall of water in the Lower Sutlej caused by the perennial canal in question.

The expenses on account of the establishment maintained for the regulation of the water supply is over and above the aforesaid expenses.

8. The immense outlay on irrigation improvements has not been accompanied by a corresponding increase in the extent of the area irrigated. The average area yearly irrigated during 1878-79—1882-83 was 14,92,780 *bighas*, whereas the yearly average between 1894-95 and 1899-1900 was 13,97,437 *bighas*, showing a decrease of 45,293 *bighas*. See Statement No. IV.

9. In spite of the strenuous efforts of the State to keep up efficiency of irrigation, many of the *zemindars* were reduced to poverty by failure of means, and to save them from ruin the State had to remit balances of the revenue demand to the extent of Rs. 4,89,916-11-6. See Statement No. V.

10. Before the opening of the Sirhind Canal, the State inundation canals used to run in March or April at the latest, and some of them ran throughout the winter. But, under the present circumstances, they generally run in the month of June and dry up in winter. A careful consideration of the way in which the State is maintaining its system of canals will convincingly show that it is struggling against an ever increasing misfortune. A withdrawal of the efforts would mean a dreadful collapse, and yet the keeping up of them also is fraught with disheartening difficulties, which require the putting forth of entire resources.

11. Another evil that has resulted from the inadequacy of water supply is that the sowing of superior crops has been retarded. These crops do not get sufficient water in the beginning and have to remain almost dry near the stage of ripening. For instance, in the case of indigo crops we see that before 1883-84 the area cultivated every year was 56,200 *bighas*, whereas the annual average for the last five years of the same class of area was 18,200 *bighas*, which is even less than one-third of the former. (See Statement No. VI.)

Other superior crops, like cotton, sugar-cane, etc., have also had similar fate.

12. There is yet another form in which the areas have suffered. Though the beds of the canals have been lowered and weirs erected across them at much cost, yet it is found that the estates near the heads remain deprived of water.

13. To remedy the evils resulting from a general loss of irrigation and to provide for the irrigation of the high lands and the areas at the tail of the canals, the construction of *dahanas* at the heads of watercourses and *paggus* has been undertaken, for which the cost, amounting to two lacs of rupees, has been borne by the *zemindars*, and the sum of Rs. 92,811 has been advanced by the State to the poor *zemindars*. The State has also provided about one lac of rupees for the construction of sluices to the canals, which are in the course of construction.

Sailab or River floods.

14. During the five years preceding the year 1883-84, the average extent of the yearly area irrigated by river floods was 10,40,931 *bighas*. During the last five years, however, the yearly average of *sailab* area was 6,43,623 *bighas*, the decrease being 3,97,311 *bighas*. This decrease is simply enormous, and when it is seen that the construction of one perennial canal has thrown nearly one-half of the *sailab* area out of cultivation, it can very easily be concluded that the construction of any other canal will bring utter desolation upon the riverain villages of the State. (Statement No. VII.)

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15. The General Report regarding the Mehwar Canal project submitted by the Executive Engineer, Shikarpur Canal, to the Government of Bombay (which forms part of the correspondence forwarded to the Superintendent, Bahawalpur State, by the Punjab Government, with their letter No. 1162, dated 10th October 1900) has, in its paragraph 11, a statement the purport of which is that from 1878 to 1889 the river floods have not occurred in the Shikarpur riverain tract, and that since 1889 they have appeared in very reduced volume, and therefore not sufficiently beneficial. This decrease is attributed to the construction of a canal by the Bahawalpur State in 1858.

The statement of the Executive Engineer is apparently most reliable, and fully bears out the fact of the decrease of river floods mentioned in the paragraph above. This should be noticed that, when the excavation of one inundation canal with a width of 80 feet is believed to have so seriously diminished the river floods, it is not difficult to see that a diversion of the Lower Sutlej water by means of a weir will mean a sad disaster to the State.

16. I may farther add that it would not be right to think that the Ferozepur weir will affect only the Lower Satlej, and that the lower portion of the State dependent upon the rest of the rivers will remain unaffected. The facts adduced by the Bombay Government may here be cited as an instance in support of this assertion. The decrease of water remarked upon by the Bombay Government is not mainly due to the construction of the State Canal, but is chiefly owing to the Punjab Government Perennial Canals, one of them being the Sirhind Canal. It is an undeniable fact that the diversion of the Sutlej water into the Sirhind Canal has been so prejudicial to the interests of the State, and, when another weir is laid across the stream (the confluent of Satlej and Beas), the lower portion of the stream will almost wholly lose in magnitude, and the lower Sindh also will proportionately lose in its capacity of giving out floods. The correspondence issued by the Bombay Government supports this apprehension.

17. The advantages of the *sailab* are too well known to be described. It is the most natural and the least expensive means of irrigation. It improves the soil with the silt it throws up. It conduces to the plentifulness of fodder and helps the growth of trees, which, besides adding to the beauty of the country's aspect, are a considerable source of income. The falling of the *sailab* disheartens the people, who leave their homes for more profitable localities. The construction of wells on such areas is also risky.

Irrigation by aid of wells.

18. Before the opening of the Sirhind Canal the average extent of the area irrigated during one year (the average being that of the figures for five years preceding 1883-84) was 28,636 *bighas*, whereas the yearly average for the period of the last five years, 1893-94 to 1898-99, was 11,639 *bighas*, which shows a decrease of 17,097 *bighas* (see Statement No. VIII). This is due to the fact that the fall of the river water has a lowering effect upon the waters of the wells, which thus cease to supply sufficient water and consequently fall out of work. The number of State wells that have fallen out of work owing to the injurious effect of the Sirhind Canal is 3,594. (See statement No. IX.)

19. This is also very generally seen that a decrease in the river water, besides lowering the water in the wells, embitters its taste. This water, instead of doing good to the soil, spoils it and renders it unfit for cultivation in the course of two or three years.

It should be noticed that the depth of the wells before the year 1883-84 was generally 19 ft. (Statement No. X), whereas at present it is 29 feet. (Statement No. XI.)

20. Though there are certain peculiar difficulties in the way of advancing irrigation by means of wells, yet, as the use of canal water has to be compensated somehow or other, the *semdars* have all along been advised to sink new wells. Consequently since the settlement of 1878 wells to the number of 3,416 have been constructed (compare State-

ment No. IX with Statement No. XI), the cost on account of them being Rs. 5,96,453-6-5, as under:—

	Rs. A. P.
Takari advances	84,389 1 9 (See Statement No. XII)
Cost provided for by the <i>semdars</i> 5,12,061 4 6 (.)	Ditto XIII)
TOTAL.	5,96,453 6 5

These, and all figures in the attached statements, have been carefully verified. They will be found in the Annual Administration Reports submitted by the Bahawalpur State.

21. Moreover, to bring the State irrigation system on an extensive and permanent footing, *takari* advances to the amount of Rs. 8,00,000 has been sanctioned of which 6 lacs have already been advanced. The construction of wells is being hotly pushed. The total of applications for *takari* to date is about 11 lacs of rupees, and a further provision of two lacs is about to be made on this account. But the result of all this liberal scheme also depends upon the efficient supply of river and canal water, as without it the wells will be of little advantage.

Cholistan.

22. The Bahawalpur State is comparatively a rainless territory. The whole of the Cholistan tract, measuring about 40,00,000 acres, is a wide desert. The slight rain that falls on rare occasions does little good to the crops. The only income derived is that from the *sejji* produce. The principal part of the State from which most of its income is derived is the Sindh tract. And the latter, as shown above, depends for its prosperity upon the river Satlej. Any loss of water, therefore, means to the State a sad blow to its prosperity and depopulation of many of its thriving centres of habitation. The water of wells will turn bitter and thus be unfit for the use of men and animals.

23. The annual *mirbakhri* income to the State is Rs. 18,692. This, too, will be injuriously affected by the decrease of river waters.

PART II.—The apprehended effect of the projected weir at Ferozepur.

24. In the above paragraph I have tried to show the efforts the State has had to make to counteract the harmful influence which the Sirhind Canal has had upon the general prosperity of the Bahawalpur State. When such has been the effect of a canal drawn from a point of the river so far removed from Bahawalpur, what will be its fate when a canal is drawn from a point just above its border, is not difficult to surmise. These apprehensions were clearly detailed in the Council's proceeding dated 31st January 1900 (Appendix A), and I take this opportunity of once more requesting the favour of a due consideration to its subject. In the case of the Government, it is possible that the loss of prosperity in one part of its territory may be compensated by increased prosperity in the other, but to the State a loss is a loss and for ever. Any farther diverting of the Satlej water into a perennial canal is sure to deprive the Bahawalpur State of the most of its means of irrigation, and to render it as cheerless as its neighbouring States of Bikanir and Jaisalmir. The full from a State of long enjoyed plenty will be felt all the more keenly.

Under these circumstances, the Bahawalpur State, which prides on its long history of deep loyalty to the Government, is justified in asking for a due consideration to its interests, which involve the well-being of its own and its people.

25. As the object of the present enquiry is only to obtain some estimate of the extent of injury done to the riverain tracts, I think it out of place to suggest any way of remedying the evil or compensating the loss. But I beg to point out once more that the revenue of the State, which is nearly 28 lacs of rupees, depends mainly upon its power and extent of utilizing the water of the river Satlej.

I further venture to add that it is not a very useful policy to provide for the prosperity of a new tract at the cost of a long established centre of cultivation. This changing of the order, besides raising social inconveniences, gives birth to political difficulties as well.

Statement No. 1, showing rise and fall of the river Sutlej during 1878-79—1882-83 and 1895-96—1899-1900.

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Years.	April.	May.	June.	July.	August.	Sep- tember.	October.	November.	December.	January.	February.	March.
1878-79 . .	2.98	3.52	3.80	6.67	8.75	4.80	1.83	1.28	1.04	0.90	0.81	1.43
1879-80 . .	1.11	1.56	3.09	6.49	8.15	4.84	1.66	0.63	0.38	0.58	0.01	0.78
1880-81 . .	1.25	1.84	3.47	6.69	5.52	4.02	1.96	1.02	0.59	0.58	0.75	2.03
1881-82 . .	2.20	2.61	4.68	6.19	6.00	5.48	1.78	0.58	0.12	0.09	1.36	0.93
1882-83 . .	1.69	1.11	3.15	5.62	6.71	4.84	2.04	0.79	0.54	0.82	0.58	0.06 minus.
Total . .	9.23	10.61	18.17	31.66	36.03	23.98	9.27	4.28	2.67	2.96	4.51	5.11
Average . .	1.85	2.13	3.63	6.33	7.21	4.80	1.85	0.86	0.53	0.59	0.90	1.02
1895-96 . .	0.09	1.47	3.63	4.18	6.99	5.05	1.48	0.06 minus.	0.58 minus.	1.01 minus.	1.00 minus.	0.81 minus.
1896-97 . .	0.36 minus.	1.01	3.05	5.61	6.85	3.60	0.74	0.61 minus.	0.71 minus.	0.73 minus.	0.35 minus.	0.68 minus.
1897-98 . .	0.13	1.93	3.16	5.21	6.47	4.30	1.62	0.42 minus.	0.69 minus.	1.46 minus.	0.21 minus.	0.58 minus.
1898-99 . .	0.17	0.23	0.08	3.57	5.14	3.89	0.28	1.39 minus.	1.80 minus.	1.22 minus.	1.70 minus.	2.02 minus.
1899-1900 . .	0.26	0.74	2.03	5.10	3.95	1.96	0.65 minus.	1.79 minus.	0.71 minus.	2.50 minus.	1.80 minus.	2.22 minus.
Total . .	0.23	3.90	11.95	23.67	29.40	18.70	3.47	4.30 minus.	4.49 minus.	1.92 minus.	5.66 minus.	6.31 minus.
Average . .	0.05	0.78	2.39	4.73	5.88	3.74	0.69	0.86 minus.	1.90 minus.	4.98 minus.	1.01 minus.	1.26 minus.
Figures showing fall of the river Sutlej during 1895-96—1899-1900 when compared with 1878-79—1882-83.												
	1.90	1.35	1.24	1.60	1.33	1.06	1.16	1.72	1.43	1.97	1.91	2.28

Note.—The proposed zero was 363.5.

Statement No. 2, showing the expenses incurred by the State on account of new canal works, etc., during 1878-79 to 1882-83, and those incurred during 1883-84 to 1890-1900.

Serial number.	Year.	NEW WORKS.			COST OF ORIGINATOR AND IMPROVEMENT EXPENDED.				COST OF REPAIRS IN REVENUE, OUTRELS AND OF COMPENSATION, ETC.				GRAND TOTAL.	
		Provided by the State.	Takast advance.	Total.	Provided by the State.	Takast advance.	Total.	Provided by the State.	Takast advance.	Total.	Provided by the State.	Takast advance.	Total.	Total.
1	1878-79	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
2	1879-80	1,22,937 2 8	2,537 5 8	1,25,474 8 5	18,728 12 7	...	18,728 12 7	2,578 6 0	...	2,578 6 0	1,44,559 9 7	...	1,46,137 9 7	1,46,137 9 7
3	1880-81	1,67,617 2 4	...	1,67,617 2 4	24,778 12 1	...	24,778 12 1	2,578 6 0	...	2,578 6 0	73,201 0 1	...	75,784 6 1	75,784 6 1
4	1881-82	44,918 15 6	...	44,918 15 6	17,652 5 1	...	17,652 5 1	2,578 6 0	...	2,578 6 0	71,394 8 10	...	73,972 8 10	73,972 8 10
5	1882-83	55,518 7 1	...	55,518 7 1	17,652 5 1	...	17,652 5 1	4,711 11 8	...	4,711 11 8	60,331 8 0	...	60,331 8 0	60,331 8 0
	Total for the above five years	3,25,162 7 3	3,537 5 8	3,28,699 13 0	88,833 8 9	...	88,833 8 9	13,063 15 6	...	13,063 15 6	4,25,699 15 6	...	4,29,975 5 3	4,29,975 5 3
6	1883-84	21,855 8 7	...	21,855 8 7	23,424 3 1	...	23,424 3 1	1,461 13 10	...	1,461 13 10	46,741 0 8	...	48,202 8 8	48,202 8 8
7	1884-85	17,695 4 4	...	17,695 4 4	19,202 0 3	...	19,202 0 3	1,136 1 3	...	1,136 1 3	38,024 5 11	...	39,160 6 12	39,160 6 12
8	1885-86	17,695 4 4	...	17,695 4 4	19,202 0 3	...	19,202 0 3	4,254 12 8	...	4,254 12 8	1,221 10 8	...	1,221 10 8	1,221 10 8
9	1886-87	1,63,160 6 8	...	1,63,160 6 8	13,121 2 1	...	13,121 2 1	2,908 14 7	...	2,908 14 7	1,221 10 8	...	1,221 10 8	1,221 10 8
10	1887-88	63,228 8 10	...	63,228 8 10	11,669 10 9	...	11,669 10 9	1,636 0 8	...	1,636 0 8	62,512 13 0	...	62,512 13 0	62,512 13 0
	Total for the above five years	2,28,767 8 8	2,50,889 3 5	2,50,889 3 5	83,911 3 3	...	83,911 3 3	11,401 4 0	...	11,401 4 0	3,22,110 0 0	...	3,46,231 10 8	3,46,231 10 8
11	1888-89	2,86,881 11 8	...	2,86,881 11 8	15,651 1 2	...	15,651 1 2	853 12 8	...	853 12 8	4,53,284 19 5	...	4,57,135 19 5	4,57,135 19 5
12	1889-90	30,727 5 11	...	30,727 5 11	19,202 0 3	...	19,202 0 3	1,136 1 3	...	1,136 1 3	4,53,284 19 5	...	4,57,135 19 5	4,57,135 19 5
13	1890-91	28,516 8 5	...	28,516 8 5	13,201 6 10	...	13,201 6 10	1,136 1 3	...	1,136 1 3	4,53,284 19 5	...	4,57,135 19 5	4,57,135 19 5
14	1891-92	27,421 3 11	...	27,421 3 11	13,201 6 10	...	13,201 6 10	1,136 1 3	...	1,136 1 3	4,53,284 19 5	...	4,57,135 19 5	4,57,135 19 5
15	1892-93	12,870 15 4	...	12,870 15 4	2,868 5 11	...	2,868 5 11	2,668 2 0	...	2,668 2 0	19,533 7 3	...	21,201 7 3	21,201 7 3
	Total for the above five years	4,87,150 13 4	5,47,801 7 6	5,47,801 7 6	63,328 6 6	...	63,328 6 6	8,765 5 1	...	8,765 5 1	5,57,585 8 11	...	6,17,893 3 1	6,17,893 3 1
16	1893-94	51,331 15 0	...	51,331 15 0	21,753 3 11	...	21,753 3 11	1,433 3 0	...	1,433 3 0	73,083 4 1	...	74,516 4 1	74,516 4 1
17	1894-95	17,629 5 3	...	17,629 5 3	18,673 8 3	...	18,673 8 3	3,462 9 1	...	3,462 9 1	27,121 11 10	...	28,583 11 10	28,583 11 10
18	1895-96	17,629 5 3	...	17,629 5 3	18,673 8 3	...	18,673 8 3	3,462 9 1	...	3,462 9 1	27,121 11 10	...	28,583 11 10	28,583 11 10
19	1896-97	17,629 5 3	...	17,629 5 3	18,673 8 3	...	18,673 8 3	3,462 9 1	...	3,462 9 1	27,121 11 10	...	28,583 11 10	28,583 11 10
20	1897-98	17,629 5 3	...	17,629 5 3	18,673 8 3	...	18,673 8 3	3,462 9 1	...	3,462 9 1	27,121 11 10	...	28,583 11 10	28,583 11 10
	Total for the above five years	1,18,709 9 1	37,486 2 8	1,56,195 11 0	1,05,671 13 5	...	1,05,671 13 5	20,760 0 8	...	20,760 0 8	2,45,192 7 2	...	2,65,952 1 10	2,65,952 1 10
21	1898-99	18,548 0 0	...	18,548 0 0	17,128 0 7	...	17,128 0 7	1,255 2 0	...	1,255 2 0	34,641 4 4	...	35,896 4 4	35,896 4 4
22	1899-1900	1,70,241 8 8	...	1,70,241 8 8	3,136 8 8	...	3,136 8 8	6,551 13 10	...	6,551 13 10	1,82,099 15 2	...	1,88,650 15 2	1,88,650 15 2
	Total for the above two years	1,88,797 8 8	37,423 11 0	2,26,220 9 8	20,264 9 3	...	20,264 9 3	4,887 1 7	...	4,887 1 7	2,17,651 3 0	...	2,32,532 4 8	2,32,532 4 8
	GRAND TOTAL	13,50,830 15 1	2,12,717 8 3	15,63,547 13 4	3,69,915 9 2	...	3,69,915 9 2	57,776 10 10	...	57,776 10 10	17,08,659 3 1	...	17,66,435 3 4	17,66,435 3 4
	Takast advances granted to poor zemindars.	...	...	...	...	...	...	...	...	...	...	...	...	...
	TOTAL	...	...	...	...	...	...	...	...	...	...	...	...	20,48,078 8 10*

* Note.—Since 1893-94 the amount of the expenditure has been as under:—

1. Provided by the State as made	Rs. A. P.
2. Takast advance	13,12,692 4 7
Total	2,76,238 16 8
Total	16,04,639 4 4

Sub-statement No. 2, showing Takavi Advance granted for excavation of watercourses.

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Serial number.	Name of the year.							Amount.		REMARKS.
								Rs.	A. P.	
1	1880	6,105	0 0	
2	1881	9,100	0 3	
3	1882	.	.	.	.	.	.	2,948	0 0	
4	1883	.	.	.	.	.	.	.....
5	1884	.	.	.	.	.	.	965	0 0	
6	1885	.	.	.	.	.	.	358	0 0	
7	1886	.	.	.	.	.	.	200	0 0	
8	1887	.	.	.	.	.	.	6,100	0 0	
9	1888	.	.	.	.	.	.	1,650	0 0	
10	1889	.	.	.	.	.	.	.....
11	1890	.	.	.	.	.	.	911	12 11	
12	1891	.	.	.	.	.	.	.....
13	1892	.	.	.	.	.	.	.....
14	1893	.	.	.	.	.	.	18,228	0 0	
15	1894	.	.	.	.	.	.	2,566	0 0	
16	1895	.	.	.	.	.	.	1,650	2 0	
17	1896	.	.	.	.	.	.	8,319	6 1	
18	1897	.	.	.	.	.	.	5,172	9 3	
19	1898	.	.	.	.	.	.	608	7 0	
	Total							64,970	5 6	From 1880 to 1882 Rs. 17,043-0-3, for the remaining years Rs. 46,727-5-3.

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Mirza Jind
Pado Khan.

Statement No. 3, showing the cost incurred by the zemindars on account of constructing new canals, etc.

Serial number.	Year.	Debit.						Balance.
		New works.	Annual clearance of canals.	Repairs to sluices, gates, etc.	Total for canals.	Excavation of water-courses.	Grand Total.	
		Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	
1	1878-79	40,231 15 5	2,39,203 12 11	.....		.....	2,79,436 12 4	
2	1879-80	40,213 6 11	2,69,684 3 3	8,619 11 0		791 1 1	3,20,028 9 3	
3	1880-81	43,189 15 11	1,96,770 12 0	300 0 0		14,923 4 7	2,45,103 0 6	
4	1881-82	36,814 9 7	3,09,023 4 0	.....		12,313 6 7	3,68,030 4 2	
5	1882-83	3,209 3 3	1,06,310 1 0	.....		2,557 0 0	2,02,866 7 3	
Total for the above five years		1,65,059 3 1	12,01,031 4 2	8,919 14 0	13,75,010 5 3	30,183 12 3	14,05,624 1 6	
6	1883-84	10,567 0 2	3,02,637 0 0	.....		5,247 14 0	3,18,451 14 2	
7	1884-85	14,632 0 7	3,09,617 13 0	.....		6,212 0 0	3,20,891 13 7	
8	1885-86	80,512 6 5	3,35,117 8 0	.....		2,595 6 5	4,18,685 4 10	
9	1886-87	11,296 7 1	3,18,601 4 0	.....		2,080 7 2	3,31,988 2 3	
10	1887-88	3,004 3 6	3,43,995 13 0	.....		2,697 9 6	3,56,397 9 0	
Total for the above five years		1,20,319 1 9	10,95,329 4 0		18,873 5 1	17,16,544 10 10	
11	1888-89	1,120 14 0	3,91,629 0 0	51 10 0	17,27,671 5 9	8,607 10 11	4,01,309 2 11	

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Mirza Jind
Vade Khan.*

12	1890-90	14,078	6	11	6,30,703	0	0			9,015	13	6	5,50,862	4	5
13	1890-91	18,301	13	8	5,10,893	4	0	139	0	0	2,907	15	1	5,42,246	2	0
14	1891-92	.	.	.	.	10,231	11	6	5,97,403	4	0	1,030	0	4	8,686	11	6	6,17,492	1	4
15	1892-93	.	.	.	.	14,750	8	3	6,04,323	1	3	550	0	0	4,703	0	0	6,23,604	9	6
	Total for the above five years	.	.	.	.	67,899	8	4	23,41,011	0	3	1,770	0	4	27,10,651	1	11	27,44,604	4	11
16	1893-94	.	.	.	.	20,635	10	2	6,11,011	5	4	.....			4,101	0	0	72,850	15	6
17	1894-95	.	.	.	.	37,820	11	0	5,40,780	0	7	.....			2,075	8	0	5,98,674	12	7
18	1895-96	.	.	.	.	17,903	3	11	7,07,113	1	0	.....			1,668	3	3	7,28,682	8	2
19	1896-97	.	.	.	.	20,780	13	8	6,46,319	14	0	.....			5,900	11	11	6,70,037	7	8
20	1897-98	.	.	.	.	20,573	9	7	7,32,688	13	0	110	3	4	6,054	5	3	7,65,432	15	2
	Total for the above five years	.	.	.	.	1,35,629	0	4	32,77,893	10	11	116	3	4	34,13,577	14	1	34,33,678	11	0
21	1898-99	.	.	.	.	65,223	12	1	4,09,530	3	5	202	5	4	3,691	1	10	4,78,649	6	8
22	1899-1900	.	.	.	.	99,230	14	0	8,44,229	3	5	.....			9,779	3	1	4,53,239	5	3
	Total for the above two years	.	.	.	.	1,64,454	10	10	7,53,760	6	10	202	5	4	9,18,416	7	0	9,31,886	11	11
	Grand Total	.	.	.	.	6,53,381	8	4	91,80,964	3	2	11,038	7	0	1,01,45,387	2	6	1,02,62,238	8	2

NOTE.—Since 1893-94 the expenditure has been as under:—

Total cost on account of canals	Rs.	4	7
Ditto of water-courses	87,70,340	13	3
Total	88,307	0	6
Total	63,04,711	6	8

Statement No. 4, showing area irrigated by canals.

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AREA IRRIGATED DURING 1893-94.							AREA IRRIGATED DURING 1895-96 TO 1899-1900.							Decrease between the two averages.
1878-79.	1879-80.	1880-81.	1881-82.	1882-83.	Total.	Average.	1895-96.	1896-97.	1897-98.	1898-99.	1899-1900.	Total.	Average.	
Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.
1,463,935	1,419,500	1,423,706	1,336,338	1,485,770	7,163,650	1,432,730	1,525,134	1,325,423	1,429,292	1,291,806	1,362,522	6,637,180	1,387,437	45,293

Statement No. 5, showing balance of demand remitted.

No.	Year.	Amount cancelled.	
		Rs.	A. P.
1	1896	1,97,883	11 8
2	1899	16,003	7 6
3	1890 to 1892	2,85,424	6 4
	TOTAL	4,99,310	11 6

Statement No. 6, showing the cultivation of indigo crops in the Bahawalpur State.

Name of Kistari.	As per late Settlement papers.	ACCORDING TO PRESENT SETTLEMENT.					
		1896-97 = Simut 1893-94.	1897-98 = Simut 1893-94.	1898-99 = Simut 1893-94.	1899-1900 = Simut 1893-94.	Total.	Average.
	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.
Minehinabad	13,928	845	2,210	147	221	3,665	16,206
Khairpur		3,040	4,032	1,773	5,720	13,450	
Bahawalpur		5,510	5,472	4,280	11,410	26,762	
Ahmadpur		3,601	4,700	4,301	8,189	20,600	
Khanpur		4,850	5,113	3,651	6,426	19,672	
Sadikabad	2,231	1,220	1,510	958	1,612	6,350	
TOTAL	66,200	20,005	23,116	15,119	33,211	91,170	...

Statement No. 7, showing the sailab area before and after the opening of the Sirhind Canal.

1	2	3	4	5	6	7	8	9	10	11
AVERAGE AREA IRRIGATED DURING THE FIVE YEARS PRECEDING 1893-94					AVERAGE AREA IRRIGATED DURING THE LAST FIVE YEARS 1895-96-1899-1900.					REMARKS
Area under cultivation	Forest and sabb area	Pasture area.	Area left idle but not brought under cultivation	Total.	Area under cultivation	Forest and sabb area.	Pasture area.	Area left idle but not brought under cultivation	Total	
Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	
227,520	550,456	228,072	61,900	1,010,931	325,237	172,648	91,302	59,436	619,623	392,511 Bighas less from last Settlement.

Statement No. 8, showing area irrigated by means of wells during 1893-94 to 1897-98 as compared with the average area irrigated in the year 1878.

Serial number.	DETAILS FOR THE YEARS 1893-94 TO 1897-98						Average of five years.	Area in Settlement of 1878.	Decrease.	In- crease.	REMARKS.
	1893-94.	1894-95.	1895-96.	1896-97.	1897-98.	Total.					
	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	Bighas.	
1	9,913	8,780	13,020	13,493	12,183	67,689	11,539	23,636	17,097		

Statement No. 9, showing number of wells fallen out of work in the Bahawalpur State.

Number.	Name of Kardari.	Number of wells entered in the record of the last Settlement.	Wells fallen out of work.	Number of remaining wells.	REMARKS.
1	Minchinabad	670	330	337	
2	Khairpur	2,470	888	1,501	
3	Bahawalpur	1,788	350	1,438	
4	Ahmadpur	1,449	405	1,011	
5	Khanpur	3,266	403	2,863	
6	Sadikabad	2,165	1,209	916	
	TOTAL	11,813	3,531	8,219	

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Statement No. 10, showing the depth of wells in the Bahawalpur State at the time of the Settlement of 1678-79.

Number	Name of Kardari.	Number of wells.	DEPTH.				REMARKS.
			10 feet to 15 feet or 12½ feet on the average.	16 feet to 20 feet or 18 feet on the average.	21 feet to 25 feet or 23 feet on the average.	26 feet to 30 feet or 28 feet on the average.	
1	Minchinabad	670	311	145	125	85	
2	Khairpur	2,470	850	781	488	351	
3	Bahawalpur	1,788	758	428	302	210	
4	Ahmadpur	1,449	401	309	345	305	
5	Khanpur	3,266	1,026	823	707	620	
6	Sadikabad	2,165	795	675	387	208	
	Total	11,813	4,150	3,250	2,634	1,870	
	Multiplied into . . . .	...	12½	18	23	28	
	Product . . . . .	...	51,875	58,500	58,282	52,612	=2,21,260.
	Divided by	11,813	...	...	...	...	=19 ft. average depth.

Statement No. 11, showing the present number and depth of wells in the Bahawalpur State.

1	2	3	4	5	6	7	8	9	10	11	12	13
Serial number.	Name of Kardari.	Number of wells.	DEPTH.									
			Number of wells 15 to 20 feet deep or 17½ feet on the average.	Number of wells 21 to 25 feet deep or 23 feet on the average.	Number of wells 26 to 30 feet deep or 28 feet on the average.	Number of wells 31 to 35 feet deep or 33 feet on the average.	Number of wells 36 to 40 feet deep or 38 feet on the average.	Number of wells 41 to 45 feet deep or 43 feet on the average.	Number of wells 46 to 50 feet deep or 48 feet on the average.	Number of wells 51 to 60 feet deep or 55½ feet on the average.	Number of wells 61 to 70 feet deep or 65½ feet on the average.	
1	Minchinabad	1,143	255	363	291	106	50	9	0	11	4	
2	Khairpur	2,776	591	951	812	417	52	70	32	3	...	
3	Bahawalpur	1,691	12	361	663	459	214	65	12	5	4	
4	Ahmadpur	2,919	...	782	890	476	617	211	...	...	...
5	Khanpur	3,318	218	698	912	728	418	381	...	...	...
6	Sadikabad	3,149	72	416	1,236	1,022	359	41	...	...	...
	Total No.	15,229	1,057	3,599	4,750	3,218	1,719	825	53	19	8	
	Multiplied into . . . .	...	17½	23	28	33	38	43	48	55½	65½	
	Product	18,497½	82,517	133,000	106,191	61,980	35,475	2,544	1,051½	52	=941,816.
	Divided by	15,229	=20 feet average depth.

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Statement No. 12, showing the amount of advance given by the State for constructions of wells during 1878-79—1882-83 and during 1883-84—1898-99.

1	2	3	4	5	6	7	8
YEARS.	Kardoria.						TOTAL.
	Minchinabad.	Khatipur.	Bahawalpur.	Ahmedpur.	Khanpur.	Sadikabad.	
	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	
1878-79 . . . . .	...	...	...	...	...	...	...
1879-80 . . . . .	...	...	...	...	...	...	...
1880-81 . . . . .	...	...	...	...	...	...	...
1881-82 . . . . .	...	...	...	...	1,216 0 0	2,300 0 0	3,516 0 0
1882-83 . . . . .	...	...	...	...	250 0 0	850 0 0	1,100 0 0
Total for the five years	...	...	...	...	400 0 0	1,575 0 0	1,975 0 0
1883-84 . . . . .	...	...	...	...	1,866 0 0	4,725 0 0	6,591 0 0
1884-85 . . . . .	...	...	...	...	100 0 0	700 0 0	800 0 0
1885-86 . . . . .	...	...	...	...	...	175 0 0	175 0 0
1886-87 . . . . .	...	...	...	...	...	1,510 0 0	1,510 0 0
1887-88 . . . . .	...	...	...	...	...	320 0 0	320 0 0
1888-89	400 0 0	1,700 0 0	...	...	...	...	2,100 0 0
1888-89	17,261 1 9	650 0 0	...	...	...	...	18,311 1 9
1889-90	1,300 0 0	...	1,400 0 0	700 0 0	400 0 0	...	3,400 0 0
1890-91 . . . . .	...	...	1,600 0 0	2,255 0 0	850 0 0	...	4,705 0 0
1891-92 . . . . .	...	...	1,000 0 0	...	...	...	1,000 0 0
1892-93	400 0 0	1,000 0 0	1,100 0 0	...	...	...	2,500 0 0
1893-94	500 0 0	700 0 0	10,000 0 0	500 0 0	...	250 0 0	11,950 0 0
Total for the eleven years	19,851 1 9	4,050 0 0	15,100 0 0	3,455 0 0	1,350 0 0	2,055 0 0	46,771 1 9
1894-95 . . . . .	...	1,700 0 0	1,100 0 0	450 0 0	900 0 0	...	4,150 0 0
1895-96 . . . . .	...	1,750 0 0	200 0 0	4,100 0 0	1,350 0 0	...	7,400 0 0
1896-97	850 0 0	2,450 0 0	2,500 0 0	2,800 0 0	3,527 0 0	500 0 0	12,727 0 0
1897-98	400 0 0	500 0 0	500 0 0	2,730 0 0	1,100 0 0	300 0 0	5,530 0 0
1898-99 . . . . .	...	...	...	...	1,000 0 0	200 0 0	1,200 0 0
Total for the five years	1,350 0 0	6,400 0 0	4,300 0 0	10,080 0 0	7,877 0 0	1,000 0 0	31,007 0 0
GRAND TOTAL	21,211 1 9	10,450 0 0	19,400 0 0	13,535 0 0	11,093 0 0	8,650 0 0	81,369 1 9

Statement No. 13, showing the amount spent on wells by the Zemindars.

Year.	Amount.
	Rs. A. P.
From 1878-79 to 1882-83	1,82,599 10 0
From 1883-84 to 1893-94	2,45,200 0 0
From 1894-95 to 1898-99	84,284 10 8
Total	5,12,084 4 8

APPENDIX B.

Proceeding of the Council, Bahawalpur State, regarding the proposed Ferozepur Weir, dated the 31st January 1900.

With reference to the Superintendent of the Bahawalpur State's memorandum, dated the 24th of August 1899, intimating the possibility of the construction of a weir at Ferozepur being sanctioned by the Punjab Government, we submit the following remarks regarding the effect of such a project upon Bahawalpur territory.

2. A project for irrigation of the Montgomery and Multan districts lying on the right bank of the Sutlej by obstructing the flow of the river water to the tracts below the site of the weir, will allow for the latter only the surplus water of the floodings of July, August and September. As this State territory lies far below Ferozepur, it is out of this surplus water that it will have to obtain its share. Such water will both be too scanty to meet the requirements of irrigation and too late for the cultivation of certain crops. The sowings of indigo, sugarcane, rice, juar, cotton, china, langni, sawank, pepper, tobacco, melons, and makki are generally commenced in April so as to ripen in October. The failure of timely irrigation would thus necessarily cause abandonment of the high class crops on which much of the revenue depends. The *chaumasa* water would be utilised for the raising of *til* and *bajra*

only, but, as they are low class crops, their cultivation is generally confined to areas of inferior soil. Thus the superior soil being unprovided for would fall out of cultivation.

If it be said that by sinking the beds of our canals two or three feet lower we shall still obtain reasonable water, we submit that the effect of this would be to transfer the cultivation dependent upon early and late water to some miles lower down each canal. Such a dislocation of agricultural arrangements would be evidently most prejudicial. It is no compensation to the estates which will lose the water to know that other estates will obtain it. Moreover, no lowering of the beds of canals could obtain water before the snow floods of June, whereas our canals now run in April and March, some of them throughout the winter.

3. The construction of the weir must therefore materially affect the revenue of the State, as $\frac{2}{3}$ of the area under cultivation is irrigated by the Sutlej water. As there is thus reason to apprehend a calamitous change in the revenue and the general prosperity of a State under British protection, it is incumbent on the Council to bring this to the notice of the Government and to ask consideration for its interest.

4. It has been said above that the Sutlej is the chief source from which the State draws its supply of water. The truth of this statement can be proved in three ways:—

A.—By showing the amount of the discharge of the Sutlej obtained during 1898-99 (a period of decidedly low water) and the area irrigated thereby.

B.—By giving a summary of the *Girdawari* returns showing the annual *jinscar* income of the area irrigated with the Sutlej water.

C.—By stating the revenue collected annually in cash.

A.—Discharge.

5. In order to facilitate reference an Index map* of the canals and channels of the State is attached herewith, which affords a clear view of the canal system and the area under irrigation.

* Not printed.

6. The main channel of the Sutlej runs for a length of 228 miles along the State territory, and, after joining the Chenab, the joint stream flows 47 miles further before falling into the Indus. From this course of 275 miles 26 canals have been drawn. The following table gives a detail of the length and breadth of each canal and the amount of the area irrigated by their discharge obtained during 1898-99:—

No.	Name.	Length (in miles).	Breadth (in feet).	Discharge during floods.	Area irrigable, at the rate of 80 <i>bighas</i> per cubic foot.
1	Nahr Sadikia Shari-kiab.	48	50	968-0	77,488
2	Fordwah . . .	112	100	2528-83	202,308
3	Harsukhwah . . .	8	20	560-57	44,846
4	Daulatwah . . .	65	50	1927-26	154,181
5	Qannwah . . .	33	20	53-25	4,260
6	Ahsadwah . . .	16	30	250-30	22,320
7	Marufwah . . .	19	30	117-71	9,417
8	Gaganwah . . .	15	16	87-44	6,995
9	Takwah . . .	18	20	130-09	10,455
10	Husainwah . . .	39	35	632-45	42,596
11	Barpawah . . .	41	72	1404-48	112,358
12	Bahawalwah, alias Qatabwah.	27	60	277-94	22,235
13	Mubarakwah . . .	10	15	63-68	6,086
14	Bahawalwah . . .	21	30	298-51	23,861
15	Pirwah . . .	10	16	129-78	10,352
16	Sultanwah . . .	29	36	540-66	43,253
17	Fazalwah . . .	10	22	78-20	6,256
18	Mubarakwah . . .	4	10	28-66	2,292
19	Bakhtwah . . .	25	36	456-95	36,556
20	Bauwah . . .	34	75	363-53	29,083
21	Pirwah . . .	9	11	45-42	3,634
22	Bihariwah . . .	29	50	1003-05	80,404
23	Minehinwah . . .	42	160	1607-26	152,591
24	Barneswah . . .	42	70	1327-68	106,214
25	Sadikwah . . .	44	80	2671-37	213,710
26	Daggawah . . .	27	35	456-82	31,866
Total <i>bighas</i> . . .		...	...	...	1,459,564

It appears from the above detail that, notwithstanding the lowness of water, discharge calculated to irrigate 1,459,564 *bighas* of land, at the rate of 80 *bighas* per cubic foot, was obtained during 1898-99.

B.—Girdawari.

7. The State territory is divided into six *kardaris* and the revenue is collected on a fixed assessment as in British districts. Similarly there are *halkas* (circles) of *Patwaris* and *Girdawar Kanungos* and the annual *jinswar* returns are prepared on the *Girdawaris*. The following table, giving the area irrigated in each of the five *kardaris* noted below (Sadikahad is left out, as it is irrigated principally by the Indus water) and the average annual value of the various crops in each, will show the three years' average amount of the income yielded by the area under irrigation:—

Year.	Area irrigated (in <i>bighas</i>).	Average annual value of crops.	Proprietor's and tenant's share (3 parts).	Due State share (mahsul) 1 part.
		Rs.	Rs.	Rs.
1896-97 .	10,16,705	90,02,557	67,96,018	22,06,539
1897-98 .	11,93,314	1,01,28,039	75,92,270	25,35,769
1898-99 .	10,41,086	81,19,602	60,59,701	20,59,901
Total .	32,51,105	2,72,03,197	2,04,78,998	68,24,199

The above details show that, according to the last three years' *Girdawari*, the annual average of the area irrigated is 1,083,709 *bighas* and the total income from the crops at harvest prices Rs. 91,01,732, which consists of Rs. 22,76,433 representing the due State share (*mahsul*) and Rs. 68,26,299 representing the proprietors', tenants', and labourers' shares combined, the parts being in the ratio of 1 : 3.

C.—Revenue.

8. The actual assessed revenue of each one of the five *kardaris* by the Settlement of 1889-90 is as under:—

Kardari.	Total area in <i>bighas</i> .	Land revenue.	Miscellaneous.	Total.
		Rs.	Rs.	Rs.
Minehinabad .	8,03,184	2,38,701	36,933	2,75,634
Khairpur . . .	6,12,799	2,18,771	43,696	2,62,467
Bahawalpur . .	4,66,027	1,64,773	92,214	2,56,987
Ahmadpur . . .	7,45,560	2,29,742	54,507	2,84,249
Khonpur . . .	11,34,126	3,22,354	55,437	3,77,791
Total .	37,01,716	11,74,341	2,83,087	14,57,428

It appears from the above detail that the annual revenue collected from the five *kardaris* is Rs. 14,57,428 and the total area which depends for its supply of water on the Sutlej and the Chenab is 37,01,716 *bighas* of which, as shown in the last para., 1,083,709 *bighas* were actually irrigated on an average of the period 1896-99. The total demand consists of Rs. 11,74,341 on account of land revenue and Rs. 2,83,087 on account of miscellaneous sources. The annual average of the State dues (*mahsul*) from the *jinswar* income (see para 7) is Rs. 22,75,433. If this due from the *jinswar* be compared with the actual land revenue, the former is evidently the double of the latter, the difference being Rs. 11,01,092, the benefit of which is enjoyed by the *rayat*. The re-assessment of Minehinabad and Khairpur *Kardaris* is to take place four years hence, and that of the Bahawalpur, Ahmadpur and Khanpur *Kardaris* two years hence. The Superintendent has given sanction to the re-assessment which will commence in February next. Roughly speaking, if at least one-fourth of the present demand be added on account of *Kush Hariuti*, the total demand would be as under:—

	Rs.
Land revenue . . .	14,67,926
Miscellaneous . . .	2,83,087
Total .	17,51,013

9. The total number of canals drawn from the Sutlej and the Chenab is 26. From these 195 big channels have been conducted into the interior tracts. Besides these there are 24,872 small distributaries, the clearance of which is done by the *rayat* on their own account. The Nahr Sadikah Gharbiab, though it is drawn from the Sutlej and Chenab and irrigates about 2 laes of *bighas*, yet, as its head is close to the Indus, and during floods it receives a large supply of water from that river, it has not been included in the list of canals given above. In case the Indus shifts from its present channel the Nahr Sadikah Gharbiab will lose much of its irrigating capacity.

10. It is evident that the construction and the maintenance of this system of canals has cost the State an immense sum of money. Since 1866 (the year in which the State was put in the hands of the British Agency for administration during the minority of His Highness the late Noun) 25 lakhs of rupees have been devoted to the development of irrigation. Below is given a list of the canals and channels for which allotments have, from time to time, been sanctioned:—

1, Fordwah, 2, Nahr Sadikah Shariab, 3, Harsukhwah, 4, Daulatwah, 5, Bakhtwah, 6, Sarsabwah, 7, Rajwah (drawn from Daulatwah), 8, Muradwah, 9, Greywah,

Khan
Bahadur
Mirza Jind
Vade Khan.

Khan Bahadur Mirza Jind Fado Khan.

10, Rajwah southern (drawn from Minchinwah), 11, Rajwah Northern (drawn from Daulatwah), 12, Bahadurwah branch, 13, Khaliwah, 14, Faizwah, 15, Kalarwah, 16, Perora branch, 17, Nur Afshan, 18, Faiz Rasan, 19, Sadiqwah, 20, Qaimwah, 21, Inlawah, 22, Hussainwah, 23, Baracwah, 24, Bichwah, 25, Ilchihwah, 26, Chhawanwah, 27, Puckawah, 28, Qotubwah, 29, Minbarwah, 30, Bakhtwah, 31, Sonowah, 32, Pirwah, 33, Charlawah, 34, Daruswah, 35, Nahr Sadikiah Shakhah, 36, Greywah (in branches 1, 2, 3) Sadiq Abad, 37, Khndaiwah, 38, Bahadurwah branch.

11. Besides the canals mentioned above a new canal No. 2, has been drawn from the Sutlej at a point near the boundary of the Ferozepur district with the object of extending irrigation in the Cholistan tract. The work was undertaken in 1882 and the canal has advanced 43 miles, its breadth at the head being 50 ft. It is intended to carry it to the Derawar Fort, a distance of 143 miles from the head. In order to avail themselves of the advantages offered by this new canal, a very large number of men, even from outside districts, have taken land on lease and have settled here. They have built houses, have constructed wells and are reaping the benefit of the means provided to them. The loss of water will involve these people in serious difficulties and might bring about a sad collapse.

12. There can be no question as to the improvement effected in the Irrigation Branch of the State. Even at this period of the year Daulatwah, Ahmadwah, Sadiqwah, Bihariwah, Ahmadwah (southern branch), Sonwah, Bakhtwah (all drawn from the Sutlej) are actually running, and during February most of the canals which feed the *rabi* crops will begin to furnish supplies. The construction of the weir will deprive this State of this much required water.

13. The nature of the soil of the tract marked with a red line in the map shows that it has in some time past been subject to alluvial changes from the north to the south. Even in these days the inundation water spreads to this extent. This *nahri* tract is locally termed *Sindh*, whereas the area to the south of the red line is called *Cholistani*. The soil in the former (*Sindh*) is softer than that in the latter (*Cholistani*) and can therefore absorb water very quickly, and, as it is spread over by a net work of canals drawn from the river, the sinking of wells is comparatively an easy process, for water springs up at a depth of 30 feet at its utmost. On the contrary, in *Cholistani*, which is remote from the river, the depth of 80 feet has to be reached in sinking wells. The decrease of the river water will necessarily lower the water level of the wells in the *Sindh* tract and thus render the existing wells useless.

14. There are some parts of the State area where the water of wells is hitherto and no successful cultivation can be done by its means. Such parts, therefore, cannot do without the river water and this being taken away from them, these areas of land must fall out of cultivation.

15. At the present moment there are 6,120 *pukka* wells in the five said *kardaris*, which should be rendered useless by a decrease of the river or canal water. It has all along been seen that, whenever there is no inundation, the well water also fails in supply. As the weir would prove a permanent check to inundations, it must cause a loss of Rs. 2,44,800 by rendering the wells useless, the cost being reckoned at the rate of Rs. 400 per well (including the cost of implements of husbandry). Moreover, 4 lacs of rupees have recently been sanctioned for sinking new wells and for building *pukka* heads of canals. Out of this sum Rs. 1,62,569 have already been distributed for 416 new wells which are in the course of construction. As for the rest, applications are daily passing in and are receiving due consideration. If $\frac{3}{4}$ of this provision (i.e., Rs. 2,66,669) be roughly assigned to wells, the total cost of the old and the new wells would amount to Rs. 27,07,467. This large outlay would be rendered useless by the construction of the weir.

16. The land bordering the whole course of the river (275 miles) is irrigated by the river overflow. On this land *pukka* wells cannot be built owing to risk from the river. This area would greatly suffer by diminution of the river overflow.

17. During the last British Agency in the State, regulations were made for offering leases of land on *Iksani* terms to cultivators from outside. Consequently a very large number of leaseholders are, at the present moment, holding areas of land, the improvement of which has been a source of much expense to them. If the dearth of water forces

these people to leave their lands a sad revolution in the status of the State is apprehended.

18. The *Mir Bahri* income would also come for its share of the fall, as, during winter months, the river would be quite fordable. The following table shows the *Mir Bahri* income during the last three years:—

Kardari.	1-87-88.	1898-99.	1-00-1900.	Total.
	Rs.	Rs.	Rs.	Rs.
Minchinabad .	3,101	3,801	3,818	10,720
Khairpur .	2,705	2,601	2,700	8,206
Bahawalpur .	1,955	1,822	1,751	5,528
Ahmadpur .	2,950	3,025	3,100	9,075
Khanpur .	1,565	1,590	1,910	5,065
TOTAL .	...	...	...	38,316
Average yearly .	...	...	...	12,738

19. The fuel income for the year 1897-98 was Rs. 1,06,361 and for 1898-99 Rs. 1,00,908, giving Rs. 1,03,634 as the average annual income. The State woods shall greatly suffer from the failure of the overflow and the income be permanently reduced.

20. The amount of rainfall in the State is very scanty and all cultivation depends chiefly upon the river supplies. Such being the case, the diminution of canal irrigation will greatly affect the organization of the State and the people will be obliged to migrate to better parts.

21. When the State is deprived of water, and the contiguous parts of Montgomery and Multan districts will receive a constant supply; the population of the five said *Kardaris* numbering 510,625 persons will feel the loss most painfully. Many villages shall be desolated by their inhabitants migrating to Multan and Montgomery.

22. The Sutlej has ever contributed most greatly to the prosperity of the State and it has lost an importance to the towns (like Bahawalpur, Ahmadpur, Khairpur, Uch, etc.) which are situated on its bank. The project threatens to lower the status of these towns.

Observing such an all-round loss, the State, with perfect confidence in the protection that has ever been accorded to its interests by the Government, begs to represent its dangers and to request that a full consideration be given to the matter before the project is finally sanctioned.

23. It is not the first occasion on which the proposal for building a weir across the Sutlej has been made. The proposal is an old one and dates far back to 1856, when the idea was first suggested. In 1869 and later, levels and survey were taken of the area likely to be affected. At that time Colonel Minchin, then Political Agent of the State, had in his letter to the Government No. 32 of 22nd July 1869, represented the interests of the State. The Chief Engineer to the Punjab Government in his letter No. 3788, dated 19th October 1869, (copy attached) proposed to allot a certain amount of water for the State. It shows that the rights of the State were considered. But the project, if it was dreaded as a blow then, would prove a death-blow now, demolishing, as it will, the results of years of constant efforts and expenses incurred. But, if it be found indispensable to construct the weir, then to secure for itself some compensation, the State would beg to propose, as an alternative measure, that the Government should, at its own cost, conduct a canal from the site of the weir to feed all the canals of the State drawn from the Sutlej and should also take upon itself the responsibility of its future clearance. The State would undertake the portion within the State. But, if the construction of such a canal be objected to, on the ground of the water being insufficient, even for the tracts for which it is intended or there be anticipated some other difficulties in the way of it, then the State would be justified in requesting to be compensated annually for the loss incurred by the fall in the assessed demand: Rs. 17,51,013 (see paragraph 8), and in the *Mir Bahri* Rs. 12,738 (see paragraph 14), and in the fuel income Rs. 1,03,634 (see paragraph 18), and to be paid the sum of Rs. 27,07,467 on account of the wells rendered useless. The proprietors' and tenants' share, i.e., Rs. 63,26,299, shall also suffer from the diminution of water supply and a granting of compensation in this case also would be quite in keeping with justice.

One instance of compensation being given already exists. When the North-Western Railway was laid through this territory, this State, in compliance with the instructions of the Government, had stopped to realise income from the customs duties and from the manufacture of earth-salt. In compensation for which the State annually receives Rs. 80,000 from the Government.

Similarly, when the Opium Commission was in 1894 conducting enquiries regarding the sale and product of opium, the State had duly brought to the notice of the Government that, if the sale of opium would be stopped by the orders of the Government, the State will be justified in asking for compensation.

But compensation, even if granted, is a poor consolation, for it cannot, in any way, make up for the loss the State would suffer, as a damage to its means of cultivation shall take away every hope of future advancement.

24. It should also be noticed that, if the several lacs that would be spent in the completion of the weir would afford means of cultivation in certain now parts, there would be a corresponding diminution in areas already under cultivation in which not only the Bahawalpur State but also Ferozepur, Montgomery and Multan shall have to share. Bahawalpur, however, shall be the greatest sufferer.

25. It is a fact, supported by history as well as by custom that territories through or alongside of which a certain river passes have a right to the use of water to the extent that the exercise of this right by one of them may not infringe upon that of the others. This territory receives its supply of water from the lower part of the Sutlej course and is justified in claiming a due consideration to its interests.

26. Such being the state of things in result from the completion of the project, it is incumbent that the Government should be humbly requested to arrive at conclusion that should not only be not prejudicial to the welfare of the State, but should also allow to it room for future progress, thus enabling it to give proof of its everlasting gratitude by its constant faithfulness and prompt services.

Copy of a Docket, No. 1149, dated 25th October 1860, from T. H. Thornton, Esq., Secretary to Government, Punjab, to Major C. Minchin, Political Agent and Superintendent of Bahawalpur.

With reference to his No. 32, dated 22nd July last, forwards copy of letter No. 3788-I., dated 19th instant, from the Chief Engineer, Irrigation Works, Punjab, on the subject of irrigation in the Bahawalpur State, and draws attention to Colonel Gulliver's last paragraph.

Copy of a letter, No. 3788-I., dated 19th October 1860, from Lieut.-Colonel H. W. Gulliver, Officiating Chief Engineer, Irrigation Works, Punjab, to T. H. Thornton, Esq., Secretary to Government, Punjab.

Khan Bahadur Mirza Jind Pade Khan.

I have the honour to acknowledge your No. 792, dated 5th August 1860, forwarding a letter from Major Minchin, Political Agent, Bahawalpur, on the subject of irrigation in that State.

I delayed answering the letter in hope of being able to finish my preliminary report on the proposed canals, but have not as yet been able to do so; nor can I state with any certainty when I can do so.

I calculate that an average supply of 5,000 cubic feet per second will be available in the cold season and double the amount at the time that rain crops require irrigation, as far as I can judge at present, a fair distribution of this will be canal on right bank 3,550 cubic feet in the cold season and 7,000 cubic feet in the rains.

Canals on left bank 1,450 cubic feet in the cold season and 3,000 cubic feet in the rains.

Of this 1,000 cubic feet in the cold season and 2,100 in the rains would probably be assigned to Bahawalpur with a proviso that, should it be determined to carry a navigation channel down the left bank to Hyderabad in Sindhi, the water necessary would be supplied from that allotted to Bahawalpur.

It must be remembered that the above is only a sketch of the proposals and much remains to be ascertained before any decision can be arrived at.

It is probable that the head of the canal will not be situated far above Ferozepur, so that the length of the channel to be made by the Bahawalpur State will be much reduced.

It would certainly appear advisable to employ an establishment in taking the levels of the country likely to be affected.

As far as I can now judge, the canal on left bank would have to be 170 feet wide with a depth of water of 4 feet in the cold season and 6.5 feet, in the rains, slope of bed $\frac{1}{2}$ or 0.15 feet, for 1,000 feet surface of water if taken at Ferozepur 643.5 above mean sea level so that the canal bed would be 637. I give there as an approximation to guide Mr. Baroes in his operations.

I shall be much obliged if Major Minchin will forward me with copies of any Rain Gauge Registers he may have showing the fall in each month of the year.

Hon'ble Mr. J. WILSON, C.S.I., Settlement Commissioner, Punjab.

I.—Note on the means of irrigation of the Lower Bari Doab.

The rivers of the Punjab, after they debarth from the Himalayas on to the great alluvial plain of Northern India, all bend to the westward. This general trend is possibly due to the effect of the rotation of the earth from west to east. At all events it has been going on for centuries, and there is ample evidence from the records of the past fifty years that the westward tendency is still in full force. One result of this action is that the rivers have left behind them on their south-east bank wide valleys of comparatively low level, the result of recent alluvial deposits in the abandoned river channels, and that they are cutting into comparatively high land on their right or north-western bank, so that it is generally easier and less expensive to conduct the water of a river for purposes of irrigation on to the land on the left bank than on the right bank. Another result is that the Indus, the most western of the Punjab rivers, keeps closely to the Bahman Range, which bounds the Punjab on the west, and is separated from it by comparatively high-level alluvial land, formed by the detritus from that Range; so that there is very little land to the west of the Indus which can be irrigated by canals from that river. The only use therefore that can be made on a large scale, for irrigation purposes, of the water of the Indus, is to irrigate by its means the Sind-Sagar Doab tract lying to the east, and there is ample water in the Indus alone to irrigate all that is irrigable of that Doab. Similarly the Jhelum river cannot be used to any extent to irrigate the comparatively high land on its right bank and it is now being utilised to irrigate the Jach Doab lying on its left bank, and will furnish an ample supply for the irrigation of that Doab. The Chenab, again, has been similarly utilised to irrigate the Rechna Doab

lying on its left bank and will supply sufficient water to irrigate the whole of that area. The Ravi also now irrigates the upper portion of the Bari Doab on its left bank, but it does not furnish a sufficient supply of water for the irrigation of the lower portion of that Doab. Similarly the Sutlej by means of the Sirhind Canal irrigates a portion of the vast dry tract south and east of its valley, and there is a considerable area of irrigation from that river on the same side by means of inundation canals in Ferozepur and Bahawalpur, while the canal irrigation on its right bank is comparatively insignificant.

There is still a large surplus supply of water in the Sutlej, especially after its junction with the Beas, for a further great development of irrigation, and in accordance with the system hitherto pursued in dealing with these rivers this supply should be utilised in extending irrigation to the desert country to the south-east, where there is a vast area of good soil available for cultivation. But contrary to the general rule above described it is now proposed to utilise this water in irrigating the Lower Bari Doab on the right bank of the river, against what may be called the general slope of the country. This will not only deprive the desert country to the south of any chance of future irrigation on a large scale; but will leave unutilised the surplus waters of the Chenab and Jhelum. These rivers will, after supplying ample irrigation to the Jach and Rechna Doabs, still have a large surplus of water available, which cannot be used to irrigate the comparatively high land of the Sind-Sagar Doab Thal and must run to waste unless it is employed to irrigate the Lower Bari Doab. In order to do this it must be carried across the Ravi, but this can present no great engineering difficulty, as the Ravi is not a large

Mr. J. Wilson, C.S.I.

Mr. J.
Wilson,
C.S.I.

river, its channel is often dry in the winter and it would be easy to control its floods in summer (produced by the amount taken into the Bari Doab Canal) by a weir which would divert them into the canal crossing the valley from the Chenab, or pass them on down its own channel. Even a high-level aqueduct across the Ravi would not be impossible. This would leave the whole of the water of the combined Sutlej and Beas available for the irrigation of the great tract to the south-east, which must otherwise remain for ever a desert.

I recommend therefore that an enquiry be undertaken as

to the feasibility of constructing a weir across the Chenab River below its junction with the Jhelum and taking out a canal from that point across the Ravi Valley to irrigate the lower portion of the Bari Doab in the Mooltan district—and that the expensive Lower Bari Doab project of a canal from the Sutlej be held in abeyance until this scheme has been examined.

It might also be found possible, at some future time, to extend the eastern branch of the present Chenab Canal across the Ravi higher up to irrigate that portion of the Bari Doab which lies in the Montgomery district.

II.—Note on the Irrigation of the River Valleys of the Punjab.

WHEN the Panjab came under British rule, half a century ago, the only canals of any importance in existence were (with the exception of the Western Jumna Canals which is outside the Panjab proper) the inundation canals in the extreme south-west of the Province which had been drawn from the Rivers Sutlej, Chonab and Indus to irrigate the comparatively low land in the valleys of those rivers. The annual rainfall rapidly decreases as the distance from the Himalayas to the south-west increases, and soon a zone is reached below which cultivation by means of the local rainfall only becomes extremely precarious. Accordingly cultivation was then, in that part of the Province, confined almost entirely to the valleys of the rivers, where it could be carried on by means of the river-floods, of these small inundation canals, or of wells. The population also was to a great extent confined to the neighbourhood of the rivers, while the Doabs or high-lying alluvial tracts between the rivers maintained only a very scanty population who subsisted mainly on the produce of their flocks and herds.

The inundation canals had been for the most part excavated by the irrigators themselves under the encouragement of the local rulers, and were annually cleared by the labour of the irrigators, organised by the ruler of the day. When first the British Government took over the country it failed to realise the need of aiding the people to maintain these canals, which began to fall into disrepair; and it was only after irrigation and cultivation had fallen off considerably that the necessity of Government interference was realised, and the management of these canals was taken over, first by the Deputy Commissioner and afterwards by the Irrigation Department. The clearances continued to be done by the irrigators with their own labour, but it was organised by the officers of Government. As the canals had been constructed and were maintained by the irrigators and not at the direct expense of the State, they were looked upon not as State canals, from which the State could draw any direct profit, but as in a sense owned by the people themselves. No charge was made by Government for the use of the water, and as no direct income was received by the State from these canals, Government was very reluctant to expend any money on their extension or improvement. Their management has been greatly improved in the last thirty years under the control of the officers of the Irrigation Department, but it has always been difficult to obtain money to spend on them, and many obviously desirable improvements have remained in abeyance for that reason.

Arrangements are now in progress for abolishing the old system of having the canals cleared by the irrigators themselves, and for introducing what is now almost the universal system elsewhere (except in Ferozepur) of having the canals cleared and maintained entirely at the expense of the State, which will derive an income from cash rates levied from the irrigators for the use of the water (occupiers' rates). The change of system is now being carried out in the Mooltan district under the orders of the Government of India and proposals have been submitted for effecting a similar change in the Muzaffargarh district. The new occupiers' rates have been fixed at a low pitch in the first instance, chiefly because the rent system of the country had become established on the basis of the custom that the tenant should supply the labour required for the annual clearance of the canals, and to have suddenly charged occupiers' rates appreciably higher than the cost of this labour would have disturbed the established system of rents, and the whole relations between landlord and tenant. The rates charged have therefore been calculated so as to merely cover the actual cost of annual clearance and maintenance of the canals, and there will be no immediate direct profit to Government from them.

It has been decided by the Government of India that in the case of these inundation canals the usual principle should be adopted upon that the occupiers' rates should be periodically re-examined, and if deemed advisable, enhanced with the object of securing, as far as possible, a fair value for canal water; and that future administrations should not be in any way debarred from taking whatever rates may be considered by them to be fair and reasonable without oppression from the occupiers. It is, however, to be hoped that the rates now fixed will not be raised for some time to come, as the change now introduced is one which will radically alter the system of canal and revenue administration, and any considerable enhancement of the rates would further disturb the relations between landlords and tenants, and possibly require a reconsideration of the land-revenue assessment.

In the meantime these canals will bring in practically no direct profit to the State. The advantage derived by the State from them is represented by the land revenue charged on the cultivation which is made possible by their maintenance, and an indirect credit of land revenue is allowed to the canals on this account. Should the canals be neglected, the income of the State from land revenue will fall off. Should they be improved and extended, the land revenue will, under the system of fluctuating assessment now generally introduced on these canals, be enhanced. It is therefore to the pecuniary profit of the State that it should expend money on extending and improving these canals, although the accounts of the Irrigation Department may not show a direct profit from the expenditure.

There is still a difficulty in obtaining money to expend on improving these canals. In recent correspondence which arose from a remark of the Deputy Commissioner, Dera Ghazi Khan, who reported that the area irrigated from the inundation canals in his district had fallen in four or five years from 200,000 to below 170,000 acres, and that the people considered this to be due to want of attention and insufficient expenditure on the part of Irrigation Department, the Chief Engineer explained the existing system as follows:—

"Funds for the extension, improvement and maintenance of the canals and embankments are all included in budget head 43—Imperial Minor Works and Navigation. No distinction is made by the Government of India between capital and revenue, a lump sum grant is made for the working of the Imperial canals under this head as funds can be spared from the general revenue of the country, and it is distributed by me amongst the various canals and to capital works or maintenance as seems advisable in the general interests of the whole canals in the Province."

This is bad finance. If it can be shown (as it often can) that the expenditure of a lakh of rupees in extending or improving an inundation canal will bring in an increased net income to the State (whether in the form of occupiers' rates or land revenue) of more than 10 per cent., that lakh should be immediately forthcoming; but it cannot be got, while there is no difficulty in getting lakhs of rupees for expenditure on an extension of a perennial canal. Apparently the reason is that no Capital Account is kept for these inundation canals, and this prevents the Government of India from seeing that it is as much a profitable expenditure of capital in the one case as in the other. I trust that something can be done to make capital funds readily available for all extensions and improvements of these and other inundation canals which can be shown to be a profitable investment of State capital, whatever be the form in which the expenditure and income be shown in the public accounts. The remedy seems to be to allot every year from Loan Capital a substantial sum, say, ten lakhs of rupees, to be expended on construction, extension and improvement of inundation canals. If, in order to obtain this aid, it is necessary to open a Capital Account for such canals, this should be done.

But there are other than merely financial considerations which render it incumbent on Government to devote more attention to the maintenance of irrigation in the river valleys. In the early days of British rule it was soon seen that the resources of the Province could be greatly improved by drawing water from the rivers and spreading it over the thirsty land. District Officers made spasmodic attempts to arrange the construction of inundation canals, and in many cases these were highly successful. Usually they were constructed in the first instance at the cost of individuals or local bodies, and it was only after they had proved a financial success that Government stepped in, and took them over; and even now that some of them, for which Capital Accounts are kept, show a net profit of over 20 per cent. per annum, it is difficult to get money to expend on their improvement or on the construction of similar canals elsewhere. The money and the engineering skill at the disposal of the State have been to a large extent monopolised by the great schemes for the construction of the perennial canals which have proved so great a financial success and so great a boon to the country. These canals have made it possible and highly profitable to cultivate the great arid tracts which formerly were only very sparsely inhabited, and which now support a large and prosperous population. But this has been done largely at the expense of the inhabitants of the river valleys, where the population of the South-West Punjab was formerly concentrated. The abstraction of a large proportion of the water from the rivers on which they were dependent has affected injuriously the working of the inundation canals, the spread of the river-floods and the level of their wells, and thereby has directly impaired the means of irrigation available to them. The pasture lands to which they used to send their cattle have been occupied by alien colonists. Their tenants and labourers have been attracted away to the more easily cultivated canal lands, and their villages are deserted, their wells are abandoned, and their cultivated lands lie waste. It is true that the general prosperity of the country has been enormously enhanced, and that many of the individuals who have been irrigated from the river valleys to the canal-irrigated uplands have improved their condition. But they have in many cases only been driven to migrate by the gradual impoverishment of their villages, due directly to the action of the State, and those of them who have clung to their old homes have seen on their old prosperity wane, while their more fortunate fellows on the perennial canals have waxed fat. More especially the owners of the land have seen their tenants leave them, their rents decrease, and their income from their lands rapidly diminish. Some relief has been tardily given them by a reduction of the land revenue or by introducing a system of assessment fluctuating with the area of matured crop; but it is poor compensation to a man who used to get annually Rs. 60 net profit from his well and pay Rs. 20 of this as land revenue to the State, when he sees his well abandoned, to be relieved of the payment of Rs. 20 due to the State, and to be left without the surplus of Rs. 40 which helped to support himself and his family; or to a peasant who finds it no longer possible to cultivate his holding, owing to the failure of an inundation canal, to be told that he need no longer pay the land revenue due on fields that produce him absolutely nothing. Some compensation has been made to the owners of land on the Ravi and Chenab for the injury done them by the opening of the perennial canals by giving them grants of land on the Chenab Canal, but such grants can be given only in a small percentage of the sufferers, and most of them remain uncompensated.

What I would urge is that it is the duty of the State, when contemplating the construction of a perennial canal, to consider its effect upon the inhabitants of the river valley lower down, and to provide, so far as possible, for the maintenance of their present prosperity. One of the best means of doing this is to give them, in their existing villages, a share of the irrigation from the perennial canal, and I am glad to see that this principle has now

been adopted by Government, and that irrigation from perennial canals is to be extended as far as possible into the river valleys, due precautions being taken to prevent water-logging. Another means is to provide new heads for existing inundation canals higher up the river, so that the present command may be maintained when the total supply in the river is diminished by the opening of the perennial canal. Existing inundation canals should also be extended and improved, and new inundation canals made to provide means of irrigation to village lands, and enable the owners to keep their wells going. A new scheme like the Lower Bari Doab project should not be sanctioned until a complete survey of the river valley below the proposed weir has been made, a thorough enquiry into the effect of the opening of the canal on the river valley lower down carried out, and provision made for remedying so far as possible the injury to the inhabitants of that valley to be anticipated as the effect of the opening of the canal. In the case of canals already constructed a similar enquiry should now be instituted and all possible remedies applied, the cost being added to the capital cost of the canal.

I anticipate that the process now going on will continue to develop, and that by degrees a great portion of the waters of the Punjab rivers will be diverted by successive weirs on to the Doab uplands; but there is no good reason why the cultivation of the river valleys should be abandoned, and there will always be a large surplus of water in the flood season which will not be required by the perennial canals and which could be utilised by means of inundation canals for the irrigation of the low-lying lands near the river-beds, which it would not be convenient or advisable to irrigate from the high-level perennial canals. The construction of inundation canals should therefore be continued alongside that of perennial canals. It will still be in many cases financially profitable to the State, but even where it cannot be shown to be so, it may often be advisable to make such a canal in order to treat with justice the river-side population. I believe, however, that there are many tracts in which inundation canals can still be constructed which will bring in a substantial direct return on their capital cost. Nothing has yet been done in the Indus river valley in the Dera Ismail Khan district, though the neighbouring district of Muzaffargarh is well supplied with inundation canals. Hardly anything has been done in Shang district, though inundation canals have been worked with great success in the Shahpur district above it and the Multan district below it.

My recommendations are that a due proportion of the capital and engineering skill at the disposal of the State should be expended on the improvement of the means of irrigation in the river valleys, and more particularly that—

- (1) a grant of ten lakhs of rupees should be made annually from Loan Capital for the construction, extension and improvement of inundation canals, apart from the amount required for the maintenance of the existing irrigation; and that additional funds be made readily available for capital expenditure on such canals if required;
- (2) a complete survey should at once be undertaken of all the river valleys of the Punjab, river by river, with the view of determining what can best be done to maintain existing cultivation, to restore abandoned cultivation, and to provide facilities by means of inundation canals for the improvement or extension of cultivation;
- (3) the Sind-Sagar Doab Canal be left to a future generation;
- (4) the Lower Bari Doab Canal project be held in abeyance until the enquiry now advocated has been completed.

III.—Note on future Irrigation Policy in the Punjab.

The following statement will give some idea of the development of irrigation in the Punjab since 1868. Detailed figures are not available for an earlier date. I give the figures in thousands of acres:—

Period.	Total cultivated area.	Total area irrigated.	Area irrigated by State canals.
1868	20,168	5,981	1,125
1893-1900	27,506	9,376	4,214

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Thus while the cultivated area has in the 33 years increased by 38 per cent., the irrigated area has increased by 56 per cent. and the area irrigated by State canals has quadrupled. One-third of the cultivated area is protected by irrigation.

Figures have been separately given showing the rapid development of the State canals. It is to be noted also that wells are still one of the most important means of irrigation the area irrigated from them during the last year having been 6,155,000 acres, or just short of the 4,244,000 acres irrigated by State canals. Irrigation from wells continues

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to develop steadily we will be seen from the figures for the last ten years:—

Year.	Wells fit for use in thousands.	Area of crops matured by well irrigation, thousands of acres.
1890-91 . . .	268	3,822
1891-92 . . .	273	3,696
1892-93 . . .	271	3,429
1893-94 . . .	279	3,450
1894-95 . . .	278	3,072
1895-96 . . .	287	3,731
1896-97 . . .	306	4,007
1897-98 . . .	302	3,971
1898-99 . . .	309	3,957
1899-1900 . . .	349	4,155

It will be seen that although, we might be expected, an impetus was given to well-sinking and well irrigation in the dry years 1896-97 and 1899-1900, the progress has been on the whole remarkably steady, and there were last year in the Province 86,000 more wells fit for use than there were ten years before. There has been a larger proportionate increase in *kachcha* than in masonry wells. As the former cost little and are more easily sunk than masonry wells in a sudden drought, the number of such *kachcha* wells in use last year was 31,000 more than in the year before. But (see printed statement) masonry wells also show a steady increase, the number so classed having increased from 222,000 in 1889-90 to 275,007 in 1899-1900, or by 53,000. The cost of a masonry well varies very much according to the depth to water and the character of the masonry, but it must average at least Rs 300; so that in the last ten years the people of the Punjab must have spent about Rs. 1,59,00,000, or, say, a million sterling in the construction of new wells or the repair of old ones, besides what they spent in maintaining the other 200,000 or more in working order. This means a capital expenditure on masonry wells alone of on average of sixteen lakhs per annum.

Let us now see that help has been given by Government towards this great development of well irrigation, from which it benefits so much directly and indirectly. From Statement XXVI. a statement I have had made out from the Annual Revenue Report it appears that during the last eight years the total sum advanced under the Land Improvement Act was Rs. 21,10,267. More than half of this must have been advanced to colonists on the Chenab Canal to enable them to pay the preliminary expenses of survey, water-course construction, etc. And the total amount advanced for well construction cannot have much exceeded one lakh a year, against the sixteen lakhs a year spent by the people on construction of wells. Moreover, in those eight years the total amount of principal outstanding under this Act has been reduced from Rs. 15,19,472 to Rs. 13,49,368. Only Rs. 6,639 have been written off as irrecoverable and the total amount realised as interest is Rs. 7,84,487 so that apparently the revenue account stands as follows:—

	Rs.
Interest recovered in the 8 years .	7,84,487
Sum written off as irrecoverable .	6,639
Net income .	7,77,848

or an average of Rs. 97,231 per annum, which gives a percentage of over 7 per cent. on the average outstandings of Rs. 13,46,777. As the Local Government pays only 3½ per cent. to the Government of India on moneys borrowed to be advanced under this Act, it makes a handsome direct profit out of its money-lending business under this head, besides the great indirect advantages it derives from the extension of well irrigation. According to the account furnished by the Assistant Secretary to Government, Financial Department, the net gain to the Provincial Government from

these loans has been Rs. 40,000 per annum on the average of the last eleven years. The encouragement given by these advances is not, however, so far of any great importance. From Statement XXVII attached to the Annual Land Revenue Report it appears that during the last ten years only 3,132 new wells were made and 239 old ones repaired with the aid of advances under the Land Improvement Act, while, as already said, the land-owners in that period constructed or brought into use 53,000 masonry wells, or 15 times as many as were aided by the State.

The process of granting advances under the Land Improvement Loans Act has been considerably simplified of late, but the accounts are still very complicated. Interest is charged at 6½ per cent., and it is thought necessary to keep an elaborate account of repayments of principal and interest separately for each instalment which confuses the borrower and causes extra labour to the officials concerned. This is one cause of the unpopularity of Land Improvement Loans; other causes are the difficulty in getting a loan which is sometimes caused by the smallness of the grant made available year by year for the Province, and the levy of 6½ per cent. interest, which, though low as compared with the rates actually charged by private money-lenders, sounds high to the borrower when he is told he will have to repay double the amount borrowed if the instalments are spread over 20 years. I would invite attention to the calculation made by Colonel Gwy, in which he shows that if Rs. 300 lent as a *tanikori* advances to make a well be recovered *without interest* by unusual instalments of Rs. 30, the actual cost of the loan to the State is only Rs. 101-6-0, and as after the expiry of the period of repayment the State can realise on extra land-revenue of Rs. 20 from the well for ever, the advance, though made without interest, Settlement Report, really pays it 20 per cent. on its capital.

tol outlay. In the adjoining Multan district the average fixed assessment imposed on a well at the recent settlement is Rs. 20, but besides this the construction of a well, which enables the cultivator to bring to maturity a much larger area of canal irrigated crops adds greatly to the land revenue realised under the system now introduced under which the land revenue on canal-irrigated crops will vary with the area of crop matured and will be levied in addition to the fixed assessment on the well. Similarly the well will add to the amount of occupier's rate realised, as that is levied on the matured crop area. In the canal-irrigated tracts of Multan a well can be made for Rs. 30, and if such a well be constructed by means of an advance made without interest on Colonel Grey's scheme, the State will ultimately, after the expiry of the periods for the repayment of the loan and for the protective lease, i.e., at the latest after twenty years, gain a net profit of much more than 20 per cent. on the actual capital cost of the loan. In a district under fixed assessment the return to the State must be deferred till the expiry of the period of settlement, or not the outside 30 years, but the State can well afford to wait even this period in order to get a return of more than 20 per cent. on its capital expenditure, more especially when it is considered that every well constructed adds to the produce of the country, the security of the land revenue, and the protection of the population from drought and famine. It would therefore be a profitable financial speculation for Government to advance without interest very large sums for the construction of wells wherever they are likely to ultimately add much to the canal or land revenue, as they will all over the plains of the Punjab. I would urge that this policy be generally adopted, and that ten lakhs of rupees be placed annually at the disposal of the Punjab Government for advances without interest for the construction of wells. These advances should be kept distinctly separate in the accounts from other loans and it should be realised in the Provincial contract and elsewhere that they will on the average bring in no net profit for about 15 years, but will then give a profit of more than 20 per cent. on the net outlay. If this be thought too bold a policy, I would ask that at least the rate of interest charged on such advances should be reduced to 4 per cent., so that Government should not make any direct profit as a money-lender, in addition to the great indirect benefits it derives from the construction of wells.

Notwithstanding the great progress that has been made in the last fifty years, I consider that irrigation in the Punjab is but in its infancy. We are only beginning to tap the sources of water-supply, above and below ground. Our great perennial canals, though they absorb almost the whole of the winter-supply in some of the rivers, utilise only a fraction of the monsoon-supply, and the summer floods pass on to the sea in practically undiminished volumes. Meanwhile there is only a small amount of land available for irrigation. The area of unirrigated cultivated land in the Punjab is some 15 millions of acres, and the total cultivable uncultivated area is over 21 millions of

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acres, making a total of 36 millions of acres. Of this area at least 20 millions of acres are commanded by the rivers as they issue from the hills, and it is quite possible to add this to the 9 millions of acres already irrigated by canals and wells. Moreover, there are further untold millions of acres in the Rajputana desert which it is quite feasible to irrigate from the Punjab rivers. I anticipate a time when the flood waters of these rivers will be poured over vast tracts to the south and east, giving them sufficient moisture for the ripening of an autumn crop and the sowing of a spring crop, and raising the underground water-level sufficiently near the surface to enable the people to ripen their spring crops by means of wells. And it is towards this end that we should shape our policy. We should keep moving the waters of the rivers ever eastwards and southwards. We should encourage as much as possible the sinking of wells wherever the water-level has been brought near the surface, and should gradually refuse irrigation in the winter season to such tracts, so as to compel the people to have recourse to wells and save the canal water for tracts farther south where the water-level is still deep. There are other than purely financial reasons for encouraging a great development of wells. It is better for the physical health and moral character of the people that they should have to labour on their wells than that they should sit idly watching the canal water flowing over

their fields. Again, as things at present stand, think of the enormous responsibility that lies upon Government to maintain its canal system in full working order. If the Khanki Weir gave way and was useless for even six months, many thousands of peasants on the Ghannab Canal would at once be plunged into dire distress, as their fields would produce nothing. Whereas if the water-level had been raised to working-point and the country were dotted over with wells, they would be able to irrigate their fields and get some produce out of the land. So that even if owing to some calamity the canal failed entirely, their destitution would come on only gradually and there would be time to arrange to provide for them elsewhere.

My recommendations therefore are that the waters of the Punjab rivers should be carried as far to the east and south as possible; that where the rainfall is good or the underground water-level sufficiently near the surface to make irrigation from wells practicable, canal water in the winter season should gradually be refused; that every possible encouragement should be given to the sinking of wells, and more particularly that ten lakhs of rupees should be placed annually at the disposal of the Punjab Government to be advanced on loan without interest for the construction of wells; and that we should gradually take into our canals more and more of the flood-waters of the rivers and spread them far over the country.

IV.—Replies to printed questions.

I have already submitted memoranda for the Irrigation Commission on the following subjects:—

- I. Means of Irrigation of the Lower Bari Doab.
- II. Irrigation of the River Valleys of the Punjab.
- III. Future Irrigation Policy in the Punjab, with special reference to the development of irrigation by means of wells and inundation canals. I need not repeat what I have said in those memoranda.

A.—General.

1. I have special knowledge of the following districts of the Punjab:—

- (1) *Gurgaon*, where I worked as Assistant Settlement Officer for two years, and where I assisted the Deputy Commissioner in granting remission of arrears and reduction of assessment on a large scale after the droughts and fever and loss of cattle and population of the years 1877—1882.
- (2) *Sirsa and Fazilka Tahsils*, the assessment of which I revised in 1879—1882.
- (3) *Shahpur District*, where I was Deputy Commissioner and Settlement Officer for eight years.
- (4) *Rawalpindi District*, of which I was Deputy Commissioner for 2½ years.

I have also as Settlement Commissioner learned much of the agricultural condition of the following districts during the last two years, viz., Jhang, Multan, Muzaffargarh, Dera Ismail Khan, Kohat, Hazara, and Jhelum.

I propose therefore to answer the questions with reference to the circumstances of the Province generally, but with special reference to Shahpur and the south-western districts.

2. The total average annual rainfall varies, as a general rule, inversely with the distance from the Himalayas. Along the foot of the hills there is a zone of country where it amounts to over 30 inches per annum and is fairly certain, so that a large area of crops can be grown every year with the help of the local rainfall alone. Further out the average rainfall is between 30 and 20 inches, and becomes more uncertain, so that while it is still possible in good years to grow a large area of rain-crops, they are more insecure and in years of drought either cannot be sown or fail largely. Still more to the south-west comes a zone where the average rainfall is between 20 and 10 inches and exceedingly variable, so that the rain-crops are very precarious. In a year of good rainfall, large areas are sown and give a handsome return, but in a year of drought practically no crops are matured except with the aid of irrigation. In the extreme south-west of the Province the rainfall is on the average less than ten inches and the area grown in dependence on the local rainfall only is quite insignificant, so that here the cultivation depends on the annual floods of the rivers or on wells and canals.

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The importance of artificial irrigation varies inversely with the amount and certainty of the local rainfall. In the zone of fairly certain rainfall near the hills, though wells are sunk in great numbers wherever the conditions are favourable and the water of the hill torrents and springs is conducted on to the fields below, a large proportion of the crops are grown without any artificial irrigation. Further to the south-west, as the rainfall decreases in amount and becomes more uncertain, wells and canals become more and more important, until in the south-west of the Punjab, no attempt is made to grow a crop unless it can be irrigated by a well or canal, or sown on land inundated by the river-floods.

On what may be called the Northern Plateau north of the Salt Range, comprising the Jhelum and Rawalpindi districts, and parts of Shahpur and Hazara, the country is so cut up by hills and ravines that it is impossible to construct large canals or to sink many wells, and although the rainfall is, towards the south of the Plateau, comparatively scanty and uncertain, the crops are almost entirely dependent on the local rainfall. Great pains are taken by means of an elaborate system of embankments, small and great, to retain the moisture on the terraced fields and to conduct the drainage of the higher lands on to them, but when the local rainfall fails, as it did disastrously in the Jhelum district in 1899, these embankments are useless and the fields remain dry and barren.

Again, in the Rehtuk and Hissar districts on the borders of the Rajputana desert, when the rainfall is opportune, immense areas of the level light soil which characterises the tract are ploughed and sown and produce a large quantity of grain and fodder, but when a year of drought comes, as it does about once in five years, the whole country is a desert (except where irrigation from one of the perennial canals is possible) owing to the fact that over almost the whole of this tract, the underground water-level is 50 feet or more from the surface, and irrigation from wells prohibitively expensive. On an average of years the tract produces enough grain to support a large population, but they are subject to the most violent vicissitudes of plenty and starvation.

In the almost rainless tract in the south-west of the Province a great deal has been done by means of inundation canals to spread the flood-waters of the rivers in the hot season over the country, sometimes at a considerable distance from the river bed, and as this process brings the underground water-level near the surface, irrigation from wells becomes easy, and large areas of crops are raised in summer by means of canal irrigation alone, and in winter by means of canal irrigation aided by wells, the canal water moistening the land for the sowing of a winter-crop, and the well irrigation during the winter, when the rivers have fallen and the canals have ceased to flow, bringing it to maturity.

During the last forty years a series of great canals have been constructed, taking out from the rivers soon after they descend from the hills, and conducting their water

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over the vast stretches of comparatively high-lying land between the river valleys, much of which with its scanty rainfall and deep spring-level formerly produced hardly any crops. With the aid of weirs, these canals intercept the winter flow of the rivers as well as their summer floods, and thus give irrigation all through the year. They have made it possible to grow immense areas of crops where no crop was possible before, and rendered them secure from any but partial failure. The most striking example of these works is the Chansb canal, which has brought under irrigation and cultivation a million and a-half of acres, formerly waste, and now supports in comfort a population of 800,000 souls where ten years ago only 60,000 found a scanty subsistence.

3. I do not think that anywhere extension of irrigation is hindered by scarcity of population or to any great extent by insufficient supply of cattle or manure. Where irrigation can be profitably extended, cultivators are easily found, and the necessary number of cattle is soon forthcoming, except in the case of poor individual owners whom liberal grants of *takavi* for bullocks would often enable to work their wells more fully. Nor is the soil unsuitable to irrigation anywhere in the Punjab except possibly in the Thal of the Sind-Sagar Doab, and even there I do not myself think that the poverty of the soil or the prevalence of sand-hills will be found too formidable an obstacle. The rise and fall of the annual floods of the snow-fed rivers have proved favourable to the extension of irrigation. There are many tracts, however, where irrigation, by means of wells would be much more common, were the underground water-table never the surface. The chief obstacle to the extension of irrigation, where irrigation is feasible and would be profitable, is the lack of capital for the initial expenditure whether on wells or canals. Once they are made, it is seldom difficult to keep them going, though at times the superior attractions of easier cultivation elsewhere may cause wells to be temporarily deserted, or the want of bullocks may cripple the peasant proprietor and make him temporarily abandon his well. If Government would itself spend more money on the construction of canals, and advance more money for the construction of wells, a very large extension of irrigation would result, and other difficulties would disappear.

The fear of enhanced revenue assessment has no appreciable effect in hindering extension of irrigation. The provisions for the protection of improvements against enhancement of the land revenue are well known and have the full confidence of the people, who continue to sink wells and make other improvements when a new assessment is impending just as if their assessment were fixed for years to come. For instance, in the Indus valley tract of the Dera Ismail Khan district, now under re-assessment, a thousand wells have been made in the last twenty years.

Tenant-at-will do not sink wells and are not likely to do so, so long as they remain tenants-at-will. A few of them might sink wells if they were given a right of occupancy, but there is no sufficient ground for such a sweeping change in the law. The present law provides that a tenant-at-will can make an improvement

Punjab Tenancy Act, section 61.

with the assent of his landlord, and thereby becomes entitled to compensation for the improvement on ejection. Further than this the law could not go without undue interference with the rights of landlords. A tenant having right of occupancy is entitled to make improvements on his tenancy and is protected

Section 61, 22.

thereon until the land revenue is enhanced, so that he has the same inducement to make improvements that a proprietor has.

All that is wanted to encourage extension of irrigation in the Punjab is the provision of capital for the construction of wells and canals.

4. See Douie's Settlement Manual, paragraphs 502-503.

Land irrigated by a new well, dam or reservoir is protected from enhancement of assessment for 20 years; land irrigated by an old well, dam or reservoir repaired, for ten years; for a rent from a river or lake exemption from enhancement is allowed for from five to ten years. These periods are generally sufficient, and the Financial Commissioner has the power (never used) to grant protection for longer periods when special reasons can be shown for this indulgence. In practice the exemption is secured by an enquiry made by the Settlement Officer into the case of every well made since last settlement, and the grant of a protective lease and exemption from wet assessment of all wells entitled to it under the rules. As an occupancy tenant cannot have his rent enhanced except in terms of the land revenue, he enjoys the same protection from enhancement on account of an improvement that an owner does.

In the south-western districts where the land without irrigation produces nothing, the rule till lately was that when a well was constructed to irrigate land beyond the reach of river-floods on canal waters half the assessment should be remitted. Recently, however, Government have extended the protection and ruled that in such a case no assessment whatever shall be realised on the land or well during the period of exemption. This liberal provision should further encourage the construction of wells in such tracts.

It is sometimes argued that an improvement effected by the expenditure of private capital should be exempted from enhancement of land revenue on that account for ever, but I am strongly opposed to the introduction of any such sweeping change in the assessment policy of the Punjab. One reason given for perpetual exemption is that it is economically wrong to tax the expenditure of capital on improvements. I cannot subscribe to this argument. It seems to me that accumulated capital in whatever form is one of the first things that should be taxed, and this is in accordance with the policy now adopted in England of imposing graduated death duties and a high income-tax. If a land-owner, under the protection of our laws, has been able to accumulate capital and make a well, which adds considerably to his income, there is no reason why he should not pay to the State which protects him a portion of the enhanced income he gets from this investment of his capital. All that is necessary is that the enhancement of the revenue should not be so great or so sudden as to discourage such investments of capital, and experience shows that the assessment rates in force in the Punjab do not operate as any such discouragement. For during the past ten years the land owners of the Punjab have spent over 150 lakhs of rupees in making or bringing into use 53,000 masonry wells, although each man knew that his making a well would result in an enhancement of his assessment after the expiry of his period of exemption. There is, therefore, no need to grant a perpetual exemption from enhancement on improvements, nor can it be equitably claimed, nor does any land-owner in the Punjab, unless prompted from without, think of claiming it.

If such perpetual exemptions were allowed, we should have in practice the anomaly that good well-irrigated lands producing valuable crops would pay a low rate of revenue, while poor crops on unirrigated lands would pay a rate of assessment much higher in proportion to the gross produce or to the net profits of cultivation. This would seem very unfair to the ordinary Punjab peasant, who has been accustomed to see the assessment proportional to the net profits, and to some extent to the gross produce of the land, and to my mind would be really inequitable, if the period of low assessment were extended for longer than was necessary to give the improving land-owner a fair return for the capital spent by him on his improvement. It would be all in favour of the capitalist and would by comparison injuriously affect the poor peasant with no capital. There would be great danger, too, of its directly injuring the owner of unimproved land. Along with this theory of not taxing improvements, goes the theory of assessing land not according to its actual produce but with

Report of Indian Finance Commission, 1914, para. 320.

reference to its capabilities, and we should probably not only have improved land assessed at very low rates in comparison with the actual profits, but unimproved land assessed at rates high in comparison with its actual profits, on the ground that it might be improved, say, by the sinking of a well where the spring level is near the surface. This would be grossly unfair to the poor man who had not the capital to make the improvement, and would tend to compel him to part with his land to a capitalist. I trust therefore that the Punjab with its three million of peasant owners, most of them without sufficient capital to make expensive improvements on their land, will be saved from the application of this theory, and that the present period of exemption from enhanced assessment, which is ample to give the improving owner a fair return on his capital, will not be extended.

I think, however, that the present rules might be made more liberal, not only in order to encourage improvements, but in order to make them more equitable. Proviso (6) of the rules is as follows:—

"Provided that no lease shall be given on account of a well or other work constructed to water land already assessed at irrigated rates, as a lease is intended to secure the owner against an enhancement of assessment, and not to entitle him to the remission of any part of the demand already in force."

The actual working of this proviso is as follows. The Settlement Officer at a revision of assessment assesses a well

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owned by A and the land attached to it at Rs. 30 wet assessment. He finds that the well was made five years ago at a cost of Rs. 300, in land previously uncultivated and unassessed, and therefore gives a protective lease for 15 years and assesses the land at the unirrigated rate at Rs. 10, deferring the realisation of the Rs. 20, which represents the wet part of the assessment, for the remaining 15 years of the period of exemption. He finds another well adjoining it, owned by B, of exactly the same character, and assesses that and the land attached to it also at Rs. 30. B points out that he also five years ago made the well at the cost of Rs. 300 and claims the same exemption as A has got, viz., a reduction of his assessment by Rs. 20 for 15 years, but on referring to the old records it is found that at the last settlement 30 years ago a well was in existence in B's holding and that his land was then assessed at irrigated rates, so although he shows that old well fell in and that he had to go to the same expense to keep his holding irrigated that A incurred to bring a bit of waste land under irrigation, he is told that under the proviso quoted he can get no remission. B does not see the justice of this decision; nor do I; and I have often been sorry to have to refuse an exemption on this ground, when announcing new assessments. If the object of the rules is to encourage the making of improvements it is surely as important to encourage B to make a new well to take the place of the old one that has fallen in, as it is to encourage A to make a new well to irrigate waste land. On the other hand, if the reason for the rules is that A by making a new well increases the land-revenue assessment and is therefore entitled to some return on his capital by exemption for a time from the assessment that would otherwise be imposed, surely B is equally entitled to an exemption when by making a new well to take the place of the old one, he has prevented the land from falling into a state of waste, and saved the State from having to reduce the land-revenue on his holding.

In the case of the Multan district Government have recently sanctioned a more liberal rule as regards wells that may hereafter be made. The new rule for that district runs as follows:—

Multan Settlement Report,
Appendix VII.

"If a new well is made to take the place of an old well which was assessed to revenue at settlement, or if an old well incapable of use has been repaired, a protective lease will be given exempting the well from any fixed well assessment. In addition to the land-revenue, if any, already assessed upon it, from the date on which the well was made or its repair completed, but the term of exemption will be fixed by the Deputy Commissioner with reference to the expenses incurred, and shall not exceed ten years."

This rule has been made for a district where the assessment will be fluctuating, and where, when a well falls out of use for any cause, the fixed well assessment imposed upon it will be at once remitted. But I trust that this more liberal policy here adopted will be extended to other parts of the Punjab and to wells already in existence. I recommend that in place of the present proviso (b) the following rule be adopted:—

"Where a well or other work has been constructed to irrigate land already assessed at irrigated rates, the Settlement Officer may, at a revision of assessment grant an exemption from irrigated rates to the land irrigated by the well or other work, as if it had been previously unirrigated, but in fixing the period and amount of the exemption, he shall take into account the expenses incurred, and shall in no case grant a larger exemption, or for a longer period than would have been allowed for a new work on land previously unirrigated."

Under this rule Government would lose for a time the assessment at irrigated rates that would under the present rules be realised on land irrigated by a new well made to take the place of an old one, but it is as important to encourage the construction of wells, even to take the place of old ones that have become useless, and the reasons of equity in favour of the concession are so strong, that I trust Government will accept the small loss the change would entail. As the proposed rule would tend to prevent irrigated lands from being allowed to revert to a state of waste, it would probably in the end bring more gain than loss to the State.

In another direction, I think, we should be more liberal in our treatment of wells, especially in the comparatively more low tracts in the south-west of the Province, where if a well, unaided by canals or river-floods, ceases to be worked,

the land produces absolutely nothing. At the recent reassessment of the Multan district it was found that no less than 2,000 wells assessed to fixed land revenue at the previous settlement had gone out of work, and yet the lands attached to them, though in many cases they produced absolutely no crop, were paying Rs. 30,000 land revenue per annum. In many such cases the well had lain idle, and the land barren for years, and yet the land-owner, often a poor peasant, had gone on paying to the State his Rs. 15 or 20 assessment year by year. What wonder that many of them were driven into debt and had to part with their land to men of more capital! To obviate such cases in future, Government have sanctioned the following rule for the Multan district:—

"When a well falls out of use for any cause, the fixed well assessment which was imposed on it at settlement will be remitted from the first *rabi* harvest in which the well was out of use."

It is to be hoped that this rule will be extended to any tracts in which the assessment is wholly or partly fluctuating.

Again in the Thal it was found that many wells out of use, with lands that produced no crop, were still paying the assessment fixed on them at settlement, but in recent years Government have ordered the suspension of the revenue due on all such abandoned wells, and no doubt these suspended arrears will be remitted in due course.

There are still, however, very many wells in tracts wholly or partly under fixed assessment which continue to pay revenue though they have been abandoned and though their lands produce nothing, or only a scanty unirrigated crop. In a recent tour in the Jhang district I have come across many such wells, and I believe they are numerous in Montgomery and in some other districts of the comparatively rainless tract. I have always felt strongly that it was extremely harsh and often cruel of Government to go on realising revenue in such cases, and have longed for the day when a more just and generous policy would be adopted. The system has been justified by the argument that when the assessment of an estate has been fixed for twenty or thirty years, the profit and loss are the affair of the land-owners of the estate, and as Government cannot raise the assessment, neither should it lower it because a well has fallen in and the remedy pointed out is a redistribution of the assessment over the holdings comprising the estate. As a matter of practice, this remedy is applied only in the rarest cases, the reason being that neither Collector nor people feel it to be just that because B's well has fallen in, A's assessment should be increased. Besides under the system of exempting improvements from enhancement, new wells made in other parts of the estate cannot be made to bear a part of the assessment of a well that has fallen in. The result is, as I have said, that the Collector has to go on, perhaps for years, realising revenue from the wretched peasant whose well is useless and whose lands produce nothing, and it is only when a revision of assessment comes round that the needed relief is given, and most likely by that time the original proprietor has found it impossible to go on paying the land-revenue on his barren holding and has parted with it to some man of capital who can afford to wait. This is no exaggeration. There are hundreds, if not thousands, of such cases in the Punjab at this moment.

In the case of the Sinauan tahsil of the Muzaffargarh district Government have recently accepted the principle that when a well falls permanently out of use, a remission of that portion of the assessment which is charged on the irrigation from the well may be granted, if the Deputy Commissioner is satisfied that there was good reason for its abandonment, and that the owners have not sufficient land elsewhere to enable them to pay the revenue of the deserted holding. When a holding, the revenue of which has been remitted under the above rules, is again brought under cultivation, the remitted revenue, or such portion of it as the Deputy Commissioner shall see fit, may be re-imposed.

I recommend that a similar rule be extended to all the comparatively rainless districts of the Punjab, whether their assessment is coming under revision or not; and made even more liberal. It might run as follows:—

I. "In tracts where the assessment is partly fixed and partly fluctuating, when a well falls out of use for any cause, the fixed well assessment imposed on it shall be remitted from the first *rabi* harvest in which the well was out of use; and when a well of which the fixed assessment has been remitted under this rule is again brought into use, the fixed well assessment formerly imposed on it shall,

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unless it is remitted under a protective lease, be re-imposed with effect from the first *rabi* harvest in which the well is in use.

- II. In tracts where the assessment is wholly fixed, when a well falls out of use, the Deputy Commissioner shall consider whether that part of the assessment which represents the profits of irrigation from the well should not be remitted. If the land attached to the well remains wholly uncultivated, he shall remit the whole assessment on the well-holding with effect from the first *rabi* harvest in which the well was out of use. If the land attached to the well continues to be cultivated with the aid of another well, or of canals, rivers, floods or local rainfall, he shall give such a remission, not exceeding the sum assessed on the profits of the irrigation from the well, as he considers fit with reference to all the circumstances of the holding. When a well, of which the assessment has been wholly or partly remitted under this rule, is again brought into use, the assessment remitted, or such portion of it as the Deputy Commissioner shall see fit, shall, unless it is remitted under a protective lease, be re-imposed with effect from the first *rabi* harvest in which the well is in use.

Note—These rules apply also to *gharars*.

I would extend these rules in the first instance to the districts of Dera Ghazi Khan, Muzaffargarh, Multan, Mianwali, Jhang, Montgomery, Shahpur, Gujrat, Gujranwala, Lahore, Ferozepore and Hissar. They should not be applied to tracts irrigated from perennial canals, as there the well is often abandoned because irrigation from the canal makes the crops sufficiently secure. Nor would I apply them in the first instance to districts with more certain rainfall, as in such tracts the well is often not worked in good years and is maintained chiefly as an insurance against seasons of drought.

The inalienation of such a rule would of course entail some loss of revenue on Government, as we should have to remit revenue on wells that fall out of use and could not impose new revenue on new wells until the period of exemption had expired, but I would ask Government to accept this loss rather than continue the harsh and unsympathetic policy of realising revenue from abandoned wells and barren fields. In the end the gain would be greater than the loss, because the sinking of wells would be greatly encouraged, if the land-owner were sure that he would not have to pay an assessment on his well in years in which it is out of work, and because the pitch of assessment on wells could be safely raised, if we were sure that the revenue would be remitted when the well was abandoned. It is not, however, with a view to an ultimate increase in the revenue, but in the name of justice, that I urge this reform in our assessment policy.

5. The rules for the grant of loans under the Land Improvement Act have recently been made more elastic and although they are, I think, capable of further improvement, they are not the chief obstacle to the more general employment of such loans in extending irrigation. The chief hindrance is that the Government will not provide sufficient funds to meet the demands of the people under the present rules, and as long as their present requirements are not met, it seems of little use to propose further modifications of the rules. The Deputy Commissioner of Delhi tells me he has applications for Rs. 50,000 *talari*. The *Sabildar* of one tahsil in Muzaffargarh has applications for Rs. 20,000. The Settlement Officer of Dera Ismail Khan could dispose of Rs. 25,000 a year. But the money is not forthcoming. There is little encouragement to the people to apply for loans when they have to be told that their applications are approved, but cannot be granted because there are no funds. Moreover, it is very bad finance to stint these grants, apart altogether from the great benefit to Government from the extension of irrigation in ultimate enhancement of the land revenue and immediate security of the crops. The Punjab

See my previous note on Future Government has practically Irrigation Policy in the Punjab. no bad debts and always an annual net profit of Rs. 40,000 a year on this branch of its money-lending business, so that, apart from more state-man-like considerations, motives that would sway a selfish banker should induce Government to advance as much money for land improvements as the people will take on the present terms. I would urge that ten lakhs of rupees per annum should be placed at the disposal of the Punjab Government for advances for land improvement, and that this sum should be made available every year whatever be the demands on Government for famine expenditure and

other loans. If Deputy Commissioners, and people know that their requirements under this head would be regularly met, the demand would be steady and much greater even than it is. And it should not be difficult to find such loans where they give, as they at present do, a certain return of 6½ per cent. per annum. Until the Government can find the funds to advance on these terms, there seems little use in asking them to make the terms more lenient. I desire, however, again to point out how profitable an extension of irrigation by means of these loans is to Government, apart from the interest received. If by making an advance of Rs. 300 we can induce a land-owner to make a well, then after the expiry of the twenty years' period of exemption, the land revenue can, in most districts, be enhanced in consideration of the existence of the well, by about Rs. 20 per annum, so that although Government will get no return from its loan, other than the interest it claims, for twenty years, it will then get by way of an enhancement of land revenue, a return of over 6 per cent. on its loan, the capital of which will, by that time, have been repaid; so that it would be a pure financial gain to Government in many cases to advance money for such improvements free of interest altogether. It would lose the interest for twenty years, but would after the twenty years get 6 per cent. on the loan (already repaid) as long as the well lasted. Apart from these purely financial considerations there are the more general considerations that the construction of irrigation works renders the crops more secure, increases the produce of the country and makes the people more able to endure the effects of drought. I recommend therefore that where the land-owners are not willing to take loans on present terms, and after Government has found the funds to meet the demands of those who accept the present terms, the offer of loans without interest be made for the sinking of wells where the Deputy Commissioner is satisfied that they would be worked and would be useful. When all demands on these terms had been met, if there were further funds available, it would in some parts of the Province be ultimately profitable to Government to make advances on condition that when the well is made and worked, a portion of the advance will be written off, but I would not offer advances on these terms until we have satisfied the demands of those people who are willing to take loans without any such inducement.

The policy of suspension and remission of land improvement loans in the Punjab is fairly liberal, but it might perhaps be laid down more decidedly that when the improvement fails of its object, owing to the misfortune and Report of Indian Finance Commission not to the extravagance of the borrower, the loan should be recommended for remission. The fact that the amount of such loans written off as irrecoverable is less than a half per cent. per annum goes to show that the policy in this respect is not sufficiently liberal. I think that in no case should compound or penal interest be exacted. This suits so much of the *Zamindar*, and the Collector's power of recovering the loan and interest as an arrear of land revenue give quite sufficient security.

The period of repayment of a loan for a well may, under the present rules, be extended to twenty years, which is quite long enough; but in practice it is seldom extended over twelve years. I think that ordinarily it should be made to end with the period of exemption, so that as soon as the loan has been repaid the land-owner will begin to pay the enhanced land revenue. The account should be made simpler, the borrower being told only how much he must pay every harvest in even rupees for so many years without being troubled with details of principal and interest. Where the land-revenue is so great fluctuates with the crops of each harvest the reduction of instalments of the loan should be made to fluctuate in proportion, so that what the land-owner has to pay each harvest may be proportioned to his actual income from his crops.

If the Government will make available sufficient funds, it would be advisable to depute a special officer to go round to the different districts and assist the Deputy Commissioner in making loans. He should

Report of Indian Finance Commission, 1901, para. 515.

have experience in judging of the capabilities of land for irrigation and should be empowered, when he has satisfied himself that a well can and will be profitably made and worked, to disburse the money in the spot and draw up the necessary papers with as little delay and formality as possible. If this were done I believe the demand for such loans would greatly increase. It might at least be tried, and if it did not succeed might be stopped before it could do much harm. The officer should have attached to him a

subordinate expert with boring tools, to ascertain, free of expense to the land-owner, what the subsoil and underground water-supply are like. This would save much waste of money in fruitless attempts at well-sinking.

6. I have in my note on the Irrigation of the River Valleys of the Punjab, pointed out how much the population of those valleys has been injured by the opening of perennial canals in their neighbourhood: and how it is incumbent on Government to take measures for the maintenance of their prosperity by extending irrigation to their lands at the capital cost of the canals, and urged that (1) a grant of ten lakhs of rupees should be made annually from Loan Capital for the improvement of inundation canals and (2) a complete survey should be at once undertaken of all the river valleys of the Punjab.

B.—Canals of continuous flow.

7. Where a canal has been made to irrigate a tract in which the rainfall is scanty and the underground water-level far below the surface, as in the case of the Chenab Canal, it makes cultivation possible where it was impossible before, and the whole of the produce may be credited to the canal. Where, as in the case of the upper portion of the tracts irrigated by the lower Bari Doab Canal, Sirhind Canal and Western Jamuna Canal, it irrigates lands previously cultivated by the aid of the local rainfall and wells, it makes the crops more secure, it enables them to be sown earlier with less labour, it increases the yield of crops on lands previously unirrigated, and enables a larger area of crops and better qualities of crops to be grown. For instance, sugarcane, rice, and wheat are grown on large areas, and the actual value of the crops produced is enormously increased.

On a canal like the Chenab Canal, which irrigates a comparatively rainless country, the yield, even in a year of, for the tract, ample rainfall, depends almost entirely on the canal, and the demand for water, as later irrigated, fluctuates little from year to year. On the Sirhind Canal, on the other hand, the light soil of the tract commandeered produces wonderfully good crops in a year of ample rainfall, without irrigation, so that in such a year the demand for water and the area irrigated by the canal fall off in a very marked degree. In a year of scanty rainfall irrigation greatly increases the yield and the demand for water is brisk, while in a year of drought in the Ferozepur, Hissar, and Bahawal districts irrigated by the Sirhind Canal and the extensions of the Western Jamuna Canal, nothing at all would be produced, were it not for the canals, and every drop of water available is eagerly utilised.

8. On the Chenab Canal the whole produce is due to the canal. Its value may be estimated on the average of a normal year at Rs. 25 per acre, taking what as the normal crop giving 12½ annas per acre at Rs. 2 per mowd. In a year of drought it will give 10 annas per acre at Rs. 2 a mowd or, say, Rs. 30 per acre.

On the lower part of the Sirhind and Western Jamuna Canals on an average of years the produce of the land is increased by canal irrigation from about Rs. 5 to about Rs. 15 and in a year of drought from 10 to Rs. 20. In the upper part of the Sirhind and Bari Doab Canals where cultivation by means of wells and the local rainfall is possible, the value of the crops grown is increased by canal irrigation in a normal year from about Rs. 15 to about Rs. 30, and in a year of drought from about Rs. 10 to Rs. 40.

9. On the Chenab Canal the rates are levied on the area actually irrigated for each harvest. Government, the owner of the land and canal, realises from the colonists altogether about Rs. 5 per acre irrigated, of which Rs. 3-12 is considered as the price of the water (occupier's rates) and the remainder land revenue, rent and cesses. The colonist when he does not cultivate the land himself, enables it to a tenant who usually pays him half the gross produce, besides paying half the water-rates. The average income of the colonist from the tenant in such a case is at least Rs. 12 per acre leaving him a net profit of about Rs. 7 per acre.

On lands owned by private individuals the occupier's rates charged amount to about Rs. 4-4 per acre, the cultivator pays the owner one-third of the gross produce, plus the water rate, and the owner of the land pays to Government one rupee per irrigated acre as owner's rate. As the value of the produce has been increased by the introduction of canal irrigation from about Rs. 8 to Rs. 25 and the owner's share has risen from one-fourth to one-third he gets from the tenant instead of Rs. 2 about Rs. 8, besides the occupier's rate, and as his payments to Government have in-

creased from about 8 annas to about Rs. 1-8 per acre, his net income has risen from Rs. 1-8 to Rs. 6-8 per acre. These tracts (Jhang and Hafizabad) are about to have their assessment revised and the opportunity will probably be taken to secure a portion of these great profits to the State. In the lower portions of the Sirhind Canal, where the soil is light and the population scanty, Government realises about Rs. 2-8 per acre actually irrigated, and so far has not realised any owner's rate or enhancement of land-revenue, but as the Fazilka tahsil is now under reassessment, the land-revenue is likely to be largely enhanced. The land-owner need to realise from the tenant about six annas per acre under cultivation equal to about eight annas per acre harvested. He now realises (besides the occupier's rate, which is paid by the tenant) one-fourth of the gross produce or about Rs. 4 per acre, so that his profits have very greatly increased. In the upper part of the Sirhind and Bari Doab Canals also the rents paid by tenants to landlords on canal-irrigated lands have increased much more than in proportion to the payments made by them to Government. I am strongly in favour of securing to the State, which has by the expenditure of its capital constructed these canals, a large share of these enormous profits made by landlords owing to the introduction of canal irrigation, and I think no opportunity should be lost of doing so, whether by enhancing the occupier's rates, enhancing the land revenue or imposing an owner's rate.

10. The cost of constructing water-courses from the canals to the fields and of preparing the land for irrigation is generally borne by the landlord. It is small in comparison with the profits of irrigation, and landlords have little difficulty in finding the money. In the rare cases in which the tenant incurs the expenditure, he would be entitled to compensation on objectment.

11. On the Western Jamuna Canal great injury was done to the soil and to the health of the people by excessive irrigation, and by the bad alignment of the canal which interrupted the natural drainage and gave rise to water-logging, the spread of salt effluences and the prevalence of fever and malarial diseases. But of recent years the canal has been re-aligned, the drainages opened up, and excessive irrigation discontinued, with excellent results. The evils formerly complained of have been very much diminished and the condition of the soil and the health of the people greatly improved. The perennial canals more recently made have been carefully designed, and these evils are nowhere serious. There are signs that incessant cultivation without the aid of manure is exhausting the fertility of the soil but not to any alarming extent, and the only feasible course seems to be a more extensive use of manure and the growing of less exhausting crops, which the cultivators will no doubt learn in time. The introduction of canal irrigation into a formerly dry tract is generally followed by epidemics of fever, for which there seems no remedy except perhaps the gradual discouragement of excessive irrigation where it is found to exist. The people get accustomed to it, and would rather have the fever and the irrigated crops, than escape fever and suffer from semi-starvation.

I am of opinion that we should go on extending our system of canals of continuous flow by damming the rivers by means of successive weirs and spreading their waters far over the dry country to the south-east; and that by gradually discouraging excessive irrigation in the upper part of the commandeered area we should extend the benefits of canal irrigation over as much available good land as possible

and induce the people to apply irrigation policy in the present the canal irrigation by sinking and working numerous wells.

C.—Canals of intermittent flow.

12. The inundation canals of the Punjab, on which so large a proportion of the cultivation in the south-west of the Province depends, are drawn from the Punjab rivers in the summer season when their rise, due to the melting of the Himalayan snows and the rainfall on the lower hills, makes it possible to draw off a portion of their floods without the aid of a weir across the river. In an ordinary year they commence to flow about the middle of April, and cease to flow in the middle of September, but the dates of commencement and cessation depend on the melting of the snows and on the rainfall in the distant hills and vary in the one case between the 15th March and the 15th May, and in the other between the 1st of August and the 1st of October. The canal head is dug at such a level that when the river rises, water will flow down the canal, which is an

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constructed that after some miles the water commande the country, sometimes on both sides, but more especially between it and the river, by means of water-courses, taken off from the canal, often by merely digging a hole in the bank without any masonry outlet.

13. The greater part of the country irrigated by inundation canals has a very small rainfall, and but for the canals, would grow nothing at all except a few acres on silted wells. The outturn does not depend very much on the local rainfall, although opportune showers do increase the yield appreciably. The average value of the gross produce of land irrigated by these canals without the aid of wells may be estimated at Rs. 12 per acre, the whole of which should be credited to the existence of the canal.

14. If the canals commence to flow late, there is not time to sow cotton and indigo, which are the most valuable autumn crops grown to any great extent on these canals. If they cease to flow early, the autumn crops wither and there is no moisture so which to sow wheat and other winter crops.

15. A large area is irrigated by these canals without the aid of wells and is generally put under cotton, indigo, millets, pulses and other autumn crops, but it is usual to employ the later supplies of canal water in moistening large areas of land on which to sow wheat, barley and other winter crops, and to mature them by irrigating them all through the winter by means of numerous wells. Were it not for the wells, these canals would produce practically nothing but autumn crops, and their value would be lessened by half. It is essential, therefore, to encourage the construction of wells in such a tract, and this is generally easy as the underground water level is a foot within reach of an inundation canal is generally within 30 feet of the surface, and a masonry well can be made for Rs. 300 or less and can be worked by small and cheap bullocks.

16. I have given under 13 an estimate of the average value of crops irrigated by canal alone. The average value of crops irrigated both by canal and well may be estimated at Rs. 20 per acre (say 10 mannds of wheat at Rs. 2 per mnd) and practically the whole of this may be credited to the canal, as without the canal many of the wells would fall out of work. As already said, the outturn does not vary much in a year of drought, and any fall-off in the outturn would be counterbalanced by a rise of price.

17. In Multan and Muzaffargarh the canals are managed and practically owned by Government, and until lately the clearances annually required were done by the irrigators themselves under an organised system of statutory labour, but at the recent resettlement of the Multan district, this system has been abolished and now the irrigators pay to Government water-rates charged on the matured area of irrigated crops, and averaging about Rs. 1-1 per acre. It is proposed to make a similar change in Muzaffargarh, and there the water-rate will probably average about Rs. 1 per matured acre of irrigated crop. This will ordinarily be paid by the tenant. The landlord in these tracts almost invariably takes a share of the produce by way of rent, averaging about one-third of the gross produce on land irrigated by the canal alone and about one-fourth on land irrigated by both canal and well. His net profits, after allowing for cost of maintenance, are about Rs. 3 per acre on land irrigated by canal alone and Rs. 4 on land irrigated by canal and well, and he pays in land revenue to Government about Rs. 1-4 on the average. The whole of this may be considered as due to the canal, or without the canal there would be practically no crop at all in such a tract.

On the Shabpur inundation canals the clearance is done at the cost of Government and a water-rate of Rs. 2-8 per matured acre is taken. Besides paying this, the tenant pays the landlord one-fourth of the gross produce as rent equal to about Rs. 3 per acre and the landlord pays to Government six annas fixed land revenue per acre on the total cultivated area, and eight annas water-advantage revenue on the matured area, the total charge being equal to about Rs. 1 per acre of matured crops, so that including the water-rate Government realises about Rs. 3-3 per acre of matured crop, on land which would produce it almost nothing, were it not for the canal.

Private canal-owners take one-fourth of the gross produce at the price of the water, besides one-fourth as rent. This is equal to about Rs. 3 per matured acre. They pay Government 8 annas per matured acre as royalty, which leaves them a very handsome profit on their capital expenditure on the canal.

18. In Multan the water-courses from the canals are often very long and require a very heavy expenditure in annual clearances. Where the cost is great, it is defrayed by the landlord, where small, by the tenant, who pays a lower rate of rent in consideration of his labour on clearances. A similar custom prevails in Muzaffargarh, but there the cost of clearance is not so great. The most crying need on these canals is a better system of distributaries which would obviate all this annual waste of labour. This can be given only by Government and should have been given by Government long ago.

19. In some places over-irrigation has led to water-logging and the spread of salt efflorescence, but recent experiments in the direction of reducing irrigation in such tracts have greatly diminished the evil. For instance, the civil station of Shahpur was suffering seriously from water-logging which led to the collapse of several houses, but when irrigation had been reduced the level of the underground water fell. Similarly reduced the town of Minanwan in the Muzaffargarh district excessive rice-irrigation had caused serious water logging and spread of salt efflorescence, but now that less water is supplied to the neighbourhood, these evils have been greatly mitigated. In some places the cultivators take too much water for rice cultivation and as a consequence of the water-rate charged for rice has been found beneficial. I think that in most places it is quite possible to reduce water-logging and the spread of salt efflorescence by reducing the water-supply, and that this should generally be done where these signs of over-irrigation appear, even although it may mean temporary hardship to the irrigators.

It is a common complaint that land which has been cultivated for some time with the aid of canal irrigation deteriorates in productive power and there is some truth in the assertion, but I believe it is greatly exaggerated and that after a certain limit has been reached the productive power of the soil remains fairly constant, especially where the canal water, as it often does, brings with it a quantity of fertilising silt. (This is especially the case with the water of the Jhelum river which is famous for its fertile silt.) The only remedy for the deterioration is the more frequent use of manure which is gradually becoming more common, especially where wells are made to supplement canal irrigation.

20. Many of the inundation canals of the Punjab belong to Government, and their maintenance and repairs are managed by the Irrigation Department, the annual cost being about one rupee per acre irrigated. In Multan and Muzaffargarh the annual clearances have hitherto been done by the irrigators under the control of the Irrigation Department, but the system was wasteful and dilatory and led to many abuses, and is now in process of abolition, and on those canals also the clearances will in future be done by paid labour, a cash rate being charged for the water. On the Ferozepur system of canals, the clearances are done by the irrigators, and the system works fairly well under the supervision of Mr. Moya Das, but I think that in time it will have to make way for the more usual system of clearances by paid labour. On private canals generally the clearances are done at the cost of the canal-owner, who often gets the irrigators to work on them at a low wage. Probably the actual cost in each to the canal-owner is not over eight annas per acre irrigated. But the clearances are often neglected, or badly done, especially where the canal-owners are bad managers or quarrel among themselves. For this and other reasons legislation giving Government better powers of control over private canals is urgently required. A Bill for the purpose has been under consideration for more than ten years, and there now seems some hope that it will shortly be passed into law.

21. The Ferozepur canals were nominally constructed by the irrigators, but their labour was organised by Colonel Grey, the Deputy Commissioner, and his successors. A number of the canals in Shahpur were made by private persons, and several of them are well managed, the owners realizing without trouble one-fourth of the gross produce from the irrigators as the price of the water. Others are badly managed, the supply of water is very irregular and disputes frequent, and it would be to the advantage of all concerned if Government could take over the management of such canals, but it cannot do so until the Act above alluded to is passed. It has, however, acquired some of the smaller private canals by purchase, and amalgamated them with its own canal system.

22. I am not in favour of encouraging private persons to construct further canals. Experience shows that their management is rarely satisfactory and that it is much better in the interests of the land-owners that Government

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should make the canals and have complete control over them. I should encourage the construction of a private canal only where I despaired of getting Government to construct it within a reasonable time, and then only on condition that Government should have full power to step in and assume the management whenever it thought proper.

D.—Tanks.

I have no recent experience as regards irrigation from tanks. I do not think it can be practised on a large scale anywhere in the Punjab, except perhaps in the Gurgaon district.

E.—Wells.

I have made some remarks about wells under head A.

34. In the Shohpur district the depth to water varies from a few feet near the river to 60 feet or more in the centre of the upland tract. The average depth may be taken as 25 feet, the average cost of construction Rs. 300, the average duration 50 years, the average area attached to the well 34 acres, and the average area actually irrigated and producing a crop in the year 25 acres. For the whole South-West Punjab, where wells are assisted by irrigation from canals, the average depth to water may be taken as 20 feet, and the average area of crop harvested as 20 acres per annum. The water in all this part of the Punjab is raised by means of the Persian wheel and generally depends on percolation, and is rarely liable to fail seriously or become too saline, though in a year of prolonged drought the supply is not so plentiful as in an ordinary year.

35. In these comparatively rainless tracts a well makes it possible to mature a very much larger area of crop than could be watered by means of canals alone, especially in the *rabi*, when it is common for a large area of wheat to be sown with the aid of the moisture left by the last floods of the hot season, and matured by means of irrigation from the well, which is worked all through the winter. A certain limited area in the immediate neighbourhood of the well is manured and produces two crops in the year or a more valuable crop, such as cotton for sugarcane, but a considerable area has to be sown with turnips or other fodder crops for the support of the well bullocks through the winter.

36. In such a tract on an average of a term of years, a well matures 20 acres of crop worth about Rs. 400 where, if there had been no well, but only canal irrigation, the crop matured would have been only 12 acres worth about Rs. 150 and where, if there were neither well nor canal, there would have been no crop at all. On the average every well at work in the south-west of the Province (there are over 70,000 of them) adds crops worth Rs. 250 per annum to the produce of the country.

37. In these tracts rent is usually paid in the form of share of the produce, the most common rate of rent on land irrigated by wells being one-fourth of the gross produce, while on lands not so irrigated the usual rate is one-third, the produce on irrigated land being so much greater that the smaller fraction gives the landlord a larger amount of rent. The average value of the rent on land irrigated by canals or river-floods only may be taken at Rs. 3 per acre and on land irrigated, also by wells at Rs. 4 per acre, after allowing for cost of maintenance.

As already explained, a new well pays an enhanced land revenue to Government for twenty years. Thereafter it ^{Multan Settlement Report, paragraph 31.} pays an increased assessment of ^{about Rs. 20 per well.} I have in a previous part of this note pointed out how profitable to Government is the construction of a well, and how Government might profitably grant a *takari* loan of Rs. 300, free of interest, for the construction of a well, which although it would pay no enhanced revenue for 20 years, would thereafter pay Government Rs. 20 enhanced revenue equivalent to more than 6 per cent. on the capital expenditure, which

by that time would itself have been repaid, and equivalent, as Colonel Grey showed in his note, to 20 per cent. on the capitalised loss of interest. It is for this reason among others that I recommend that ten lakhs of rupees a year should be placed at the disposal of the Punjab Government for loans for the construction of wells, even if those loans have to be made free of interest.

38. It is frequently the case that a cultivator has doubts as to the proper place to sink a well owing to ignorance of the quality of the water and the nature of the strata, and it is not uncommon for money and labour to be wasted in digging for a well or even in actually constructing it in a place where it is afterwards found impossible to work it to advantage. I am of opinion that Government should appoint one or more experts to go round with boring tools from district to district and bore for water wherever it is proposed to sink a well, free of cost to the land-owner. This assistance would be welcomed by the people, and would save the waste of much money and labour. In some places there is a substratum of hard clay which the ordinary well-sinker cannot penetrate, and the expert should have strong boring implements to enable him to penetrate such a stratum. The advantages to Government of an extension of well irrigation are so great that I think the cost of such boring operations should be met from Imperial or Provincial Funds.

39. I am not in favour of any extensive construction by Government of wells in land which is privately owned, as I think the wells would ordinarily be more cheaply made and worked by the owners of the land themselves with the aid of *takari*. The plan might, however, be tried where the people will not take *takari* and are willing to let Government sink wells in their land, on condition of their paying the enhanced land revenue at once. If Government at the cost of Rs. 300 can sink a well on which it will realise immediately an enhanced revenue of Rs. 20 per annum, the transaction would be financially profitable, besides its indirect advantages. And there is no harm in trying the plan, where the people agree.

40. Temporary wells are not used to any great extent except close to the beds of rivers and in the Unbala, Gurgaon, and Rohtak districts in low-lying valleys where the water is near the surface. In such tracts they are, so far as they go, a valuable protection against drought. In recent years of scanty rainfall their construction has been encouraged with great success by the grant of small sums from Rs. 10 to Rs. 50 per well free of interest, and wherever their construction is possible, such advances should be freely given and indeed in time of famine pressed on the people that as large a food-supply as possible may be raised.

In conclusion I venture again to urge—

I. That ten lakhs of rupees a year should be placed at the disposal of the Punjab Government for the encouragement of the construction of wells by means of—

- (a) grant of loans on present terms;
- (b) grant of loans on low interest or free of interest;
- (c) construction of wells at Government expense in privately-owned lands;
- (d) employment of a special agency to distribute loans and to bore for water.

II. That in addition to the sums required for the maintenance of existing inundation canals, a sum of ten lakhs of rupees a year be placed at the disposal of the Punjab Government—

- (a) to enable it to complete the survey of the river-valleys;
- (b) to be expended on the construction, extension, and improvement of inundation canals.

(35) Colonel S. L. Jacob, late of the Punjab Irrigation Department. Paper on Irrigation and Famine Prevention in the Punjab.

PREPARATORY REMARKS.—It should be fully understood that the *ter allusions* which are made in this paper to the defects of the past are merely for the purpose of obtaining the needed moral for the future, and certainly not for the purpose of finding fault.

Irrigation is a new and difficult science, and the wonder is, not that mistakes have been made, but that they have not been far more numerous and more serious. That the record of the Punjab Irrigation Department is Punjab

a splendid one is now fully acknowledged on all hands, and the sole object of this paper is to seek to benefit that Department, and to serve the Government under which and the people amongst whom, the writer spent the best years of his life.

I. A retrospect.—Twenty years ago the Punjab Irrigation Department was thoroughly discredited.

The Western Jammu Canal irrigation was falling lower and lower. Much of the country irrigated was becoming

Col. S. L. Jacob. barren, and injurious to the health of the people, owing to its being water-logged.

The Bari Doab Canal, with many radical defects, showed little or no promise of what it would become.

The Sirhind Canal was nearly ready for opening, but it had been very costly. Its accumulated interest was very great in amount, and there seemed no hope of its ever being a paying concern.

The Swat River Canal construction, greatly hampered by the Afghan campaigns, was dragging on with little prospect of a good return.

No large projects were being drawn out, for it had become a foregone conclusion that either they would not pay at all, or else only after so long a period that it was not worth while to go to so great an expense. Therefore it was that all that was contemplated were three tiny little projects, viz., the Sidhnai, the Lower Sohay and Para, and the Ramnagar project (as the germ of the present Chenab Canal was then called).

2. *The Present Time.*—Now all this is changed. The Department is thoroughly accredited, and in a most prosperous condition.

The Western Jumna Canal has been vastly extended, its worst defects remedied, an immense boon to dry, thirsty tracts, its irrigated area nearly double what it used to be in its early days.

The Bari Doab Canal has also much extended, its irrigated area more than doubled, its defects removed, and the canal highly prosperous.

The Sirhind Canal, of immense value to the large tract it commands, is paying off its arrears of interest, and giving a good return.

The Swat River Canal is highly prosperous, its interest paid off, and excellent returns are received from it.

The Chenab Canal is barely finished, yet the desert it traverses is already blooming as a garden, and the project a marvellous investment.

The Jhelum Canal is just opened, and irrigation is opening out with great rapidity.

The Sidhnai, the Lower Sohay and Para, as well as the inundation canals, are all doing well.

Thus, all is changed.

3. *The Future.*—The question arises, what about the future?

Has the progress in the past nearly exhausted the capabilities of the situation, or are there still possibilities of progress as great as that which has already been accomplished? Have all the problems which presented themselves been already solved, or nearly so, or are there more difficult problems awaiting solution?

To these questions it is believed the answer is, that undoubtedly there are still vast possibilities of progress, and great problems to be solved, even more difficult than those already solved, but full of promise. Also that it is possible to make—

(1) the Punjab more than ever the granary of North India on the one hand, and

(2) thoroughly famine-proof on the other.

4. *Scope of this paper.*—The object of this paper is to give the writer's opinion as to the chief essentials of the problems to be solved, and the way in which the required objects can best be worked out.

5. *A first essential.*—The first essential is a profound belief in the possibilities of irrigation and great boldness in attacking the problems. It is due to the lack of this belief, and to the caution which has so often characterised the dealing with the questions that have arisen, that the successes obtained have not been even greater than they are.

6. *An illustration.*—Let us look at one instance. The Chenab Canal is a marvellous project and a tremendous success; nevertheless, it is boldly maintained that it has a great defect, which is due to too great caution, and this is that the canal head was not placed higher up the river. Can this be proved? We will see.

The extension project of the Chenab Canal was under preparation 11 years ago. The weir was in progress, and the position of the head was therefore fixed; all that could then be done was to irrigate all the land that could be commanded from that head. The project was accordingly prepared to embrace all land commanded, of which the spring level was at least 40 feet below the surface. Yet even this was considered too bold a project, and a portion of the commanded area was cut off before it was sanctioned.

What, however, has been the actual result? Why, not only has the area cut out been taken back into the scheme, but also the further limits first proposed have been over-passed, and every bit of land under command, even as far as the 20 feet spring level limit, has been brought into the irrigated area.

Why is this? Just because the progress of the science of irrigation which has been attained render it possible for a given volume of water to irrigate so much more than it used to do.

Ten years ago 1,200,000 acres of annual irrigation from the water of the Chenab river was pronounced too high an estimate, and cut down to 1,100,000. To-day the Chief Engineer of the Punjab, speaking at the Society of Arts, says 3,500,000 can be done with this same water.

Now, even when all that is possible has been done in the way of bringing all potentially commanded land under actual command, will it be sufficient? Certainly not. Only a few more extensions are possible, and the present Superintending Engineer longs intensely to have more land under command, for he sees so plainly that, do what he will, he cannot get anything like enough land to really bring out the potentialities of the available water-supply; and if this is felt now with a canal not fully complete, and with much improvement possible, it is certain that it will be felt far more acutely year by year, and the mistake of not having put the head higher up when the canal was first constructed will be accentuated, for the 800,000 or 1,000,000 extra acres of good irrigable land, which would then have been commanded, are just what is wanted for the proper utilization of the available supply of water in the Chenab river. This would, of course, have made the project more costly, but it certainly was the right thing to do.

It may then be said for certain that, sooner or later, another weir will have to be built higher up, and a subsidiary canal made to take up this tract. The expense involved in the weir and in crossing drainages will certainly not prevent this scheme being carried out, but how far better, if the possibilities of irrigation could have been foreseen and the head placed further up in the first instance.

How important, then, to take large views of the subject, and always to bear in mind that whatever duties have been obtained from the water in the past, it is perfectly certain that far greater duties will be attained in the future. The waste, even in our best canals, is still enormous, so much so that it is doubtful if one-third of the water entering the canals reaches the fields irrigated. The waste from evaporation is trifling; it is the waste from absorption which is so great, and this latter waste is capable of great reduction by improvements, nay, if it were worth while, it would be possible to almost eliminate it. It may come to this one day, though it is a far cry at present; nevertheless, absorption can be greatly diminished, and improvements in other ways will yet greatly improve duties. This must ever be borne in mind, otherwise the schemes will never be bold enough, and much regret caused in the future. The lessons of the past will be in vain unless it is seen how greatly the present standpoint can be exceeded in the future.

7. *A second essential.*—To attack the problems in the best way they must be taken up on a very broad scale. They should be worked out in a general way by those at the head of affairs, and then the details filled up. The proper way is to work from the general to the particular, and not the other way, though this principle has not been observed in the past.

8. *Illustration of the above.*—As an illustration it may be asked—

"Is it not true that the extensions to the original projects of the Western Jumna, the Sirhind, the Bari Doab, and the Chenab Canals, whereby these canals have attained to the measure of completeness which they possess, have in almost every case been brought about by the importunities of the local officers (Superintending Engineers as a rule), and not by the orders of Government?" "Is it not true that these extension schemes were in many cases delayed for months and years, because it was said there was no water for them, and that the vested rights of the old irrigators would not be maintained?" "Is it not also true that in every single case the extensions, when carried out, have more than justified their existence, have injured none, have benefited many?" Let the Government now take the initiative and, recognising the great possibilities in this work, encourage its officers in the work of extension, realising that year by year canals, if properly worked, can irrigate more than they did before, and that extensions, internally or externally, are the very breath of the nostrils of the canals, and without them a low stagnant condition will be reached, and very likely retrogression set in. Rather let

every bit of irrigable land be searched out and arranged for. Let a bolder policy now take the place of the former caution, for experience has shown that this can be safely done.

9. *Some hindrances.*—Two hindrances have been already alluded to, *viz.*, the fear of there not being enough water, and the fear of infringing on the rights of the old irrigators, and it has been shown that these fears have in no single case that actually occurred been justified in practice. They are, in truth, far too great a bugbear owing to an imperfect sense of the potentialities of irrigation.

Some other hindrances which exist as to extension on a large scale may now be mentioned, as the ground will be thus cleared.

(1) There is the fear that the inundation canals will suffer if too much water is abstracted from the rivers.

As a matter of fact, all that can be abstracted by the permanent canals will affect the inundation canals only to a slight extent. It should, however, be clearly understood that inundation canals can never be allowed to interfere with the development of the country by permanent canals. The inundation canal is an excellent device in an early stage of civilization, as it enables good results to be attained very quickly and at slight cost.

As, however, civilization progresses, it is found that inundation canals are crude appliances, that they can only take a little water when the rivers are high, while the rest must pass on; while there is little power of regulating the supply, and, moreover, the canals often dry up prematurely.

Hence in a further stage of progress they must become more like the permanent canals and be served with weirs* built across the rivers at intervals, one head serving many of these canals. The supplies will thus be properly under command, and the fear of too early drying up will be obviated.

(The only thing that will have to be carefully guarded against is that the facility of obtaining supplies from the rivers does not lead to over-irrigation and water-logging.)

There need be no fear as to the construction of weirs across the Punjab rivers; even the mighty Indus itself will eventually have to submit to being bound, it being clearly understood that it is only a question of time for the remodelling of the whole system of inundation canals.

(2) There is a complaint in some cases that the abstraction of too much water from the rivers will injure the navigation.

This objection comes mostly from Sind. But here again it should be understood that it cannot be listened to. The waste of water that would be necessitated by keeping up navigation is out of all proportion to its value. It would be like keeping an elephant to draw a go-cart. Navigation on the rivers in the Punjab or Sind is doomed, and it is useless to try and save it. Navigable canals do not flourish in North India, and traffic will have to be by railway. At the same time road (and perhaps boats) will be able to come down the Indus most likely for a long time while the river is high.

10. *Province to be looked on as a whole.*—Another most important principle which needs to be received is that the Province is to be looked at as a whole. Hitherto this has not been done, but each scheme has been looked at independently as complete in itself, and it had to stand or fall on its own merit, apart from its relation to the improvement of the Province as a whole.

This has hampered progress much, especially as regards works not charged to "A"—Works not chargeable to revenue,† to get money for which has been an exceedingly difficult task.

The Province can never be properly developed on these lines, and it is most essential that it should be looked at as a whole, and the vested rights of the people, as a whole, be taken into consideration. Thus the abundance of one part will be used to remedy the deficiency of another, the state of those who have but a precarious subsistence be more regarded, and the amelioration thereof not allowed to be prevented by the vested rights of the few who are well off.

This will be further enlarged upon later when dealing with the Western Jumna Canal. The principle is merely unannounced now.

From what was lately said by Mr. Preston on the occasion referred to before, it is understood that the question of giving a more liberal treatment to minor works is before

the Government. It is hoped that this matter will be dealt with in a very broad spirit indeed.

11. *General method of dealing with the problem as a whole.*—The ground being thus cleared, it is possible to take a general view of the principles to be accepted in dealing with the development of the irrigation of the Province (and beyond it) as a whole. It is maintained that these principles are as follows:—

(1) Use, if possible, all the available water and do not let any be wasted.

(2) Spare no effort to irrigate every bit of land which needs irrigation.

Water is to North-West India what iron and coal are to England, or what gold is to the Transvaal, but the greater part of the water still runs away unused to the sea, and, on the other hand, much land lies barren and waste, or exposed to famine, which could be watered. However difficult the problems may seem, they should be boldly attacked until it can be said that practically all the lands that need water have been provided for, and not till then should water be allowed to run unheeded to the sea.

Nor is there anything in these problems which would be so excessively costly that a prosperous and wealthy department like the Irrigation cannot afford to enter them out, and the ultimate result will be the far greater prosperity of the Province (or Provinces) as a whole, than if a more cautious policy be followed.

12. *The application of these principles.*—Let us now see how these principles would be applied.

Generally speaking, in north and west there is a plethora of water and (not all events in the Punjab) too little land, while in the south and east there is too little water for the land. We will examine this in detail in connection with each main river, for once we get to any distance from the Himalayas and beyond the fertile belt with good rainfall, high spring level, and many irrigation wells, there is but little water available except in the rivers, though there are exceptional cases which must be dealt with specially, such as the districts of Gurgaon and Gujrat, and other parts. Also it is not proposed in this paper to say anything about the extension of well irrigation, though it must always be borne in mind that it is a most excellent thing for suitable parts of the country, and it should be encouraged in every way.

13. *The Indus.*—Beginning from the north-west corner, the first river is the Indus, with a volume greater than that of all the rest of the Punjab rivers put together.

The Sind Sagar Doab, even if it should all prove on examination to be irrigable, will take but a minor portion of this volume, and in order to prevent the present great waste of water, it is necessary that every bit of land in Sind which can be irrigated should be provided for by canals from this vast volume. What the area of the unirrigated land capable of irrigation in Sind is, is not known to the writer, but, however great it is, in all probability there is far more than enough to the Indus, after the Punjab has had all it wants, to water it completely, and the water should therefore be taken to the farthest possible limits, bringing much waste land under cultivation.

A very low estimate indeed of what could be done with the surplus water not required in the Punjab and over and above the present irrigation in Sind would be eight million acres annually, possibly vastly more, but is there the land available? It is feared not.

It is understood that schemes for very large canals with at least one weir across the Indus were at one time proposed in Sind, but that they were rejected on the double ground of interference both with the inundation canals and with navigation.†

Now, if there is anything in what has been said in this paper, such reasons are quite invalid, and the schemes should be reconsidered, and if they do not include all the irrigable land which can be commanded, they should be revised to include it all. It is practically certain that there is more than enough water for all irrigable land in Sind.

14. *The Jhelum, the Chenab, and the Ravi.*—It will be best to consider the next three rivers together. There are now three canals from these three rivers, but in the three cases there is a marked disproportion between the available water supplies and the areas commanded.

The Jhelum Canal does not command half the land which the water could irrigate. The head of the canal

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* From what Mr. S. Preston, C.I.E., Chief Engineer, I.B., said lately at the Society of Arts in London, it would appear that something of this sort is already contemplated.

† Punjab

† The ground for saying this was a statement made by Sir H. Evan James, K.C.I.E., late Chief Commissioner of Sind, at the Society of Arts, when Mr. Preston read his paper there in April.

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apparently could not have been put higher up because of hills on the left bank, which reach right to the head of this canal; therefore, though some land is excluded from irrigation which needs irrigation, this was seemingly unavoidable. May be, however, some way of irrigating this land will be one day found when science has further developed. It is a nice problem left to the future.

The whole of the Gujrat district, however, should be carefully gone into on the same lines as those proposed for Gurgaon (see paragraph 24). This Gujrat district sometimes suffers from famine, and needs remedial measures.

Now the surplus Jhelum river water is of comparatively little use to Sind, because, even without it, all land in Sind can be irrigated. If, therefore, it cannot be utilized in the Punjab, it will be wasted perpetually.

The Chenab Canal, as already explained, lacks commanded area, and even if a subsidiary canal is made to take up the area left unirrigated, because not commanded from the present head, still the Chenab river will have water enough for it without damaging the present canal colonists in the least. They will still be able to do much more irrigation than they were ever guaranteed, and the water will be used more carefully and there will be less fear of exhausting the soil.

When, however, we come to the area between the Ravi and the Sutlej, we have a tract considerably greater than can be irrigated (as things are at present) by the B. D. Canal.

At present this canal only irrigates to the Lahore district border without entering the Montgomery district, and there are tracts in the Lahore district (if not also in the Amritsar district) to which extensions are needed.

Outside the present scope of this canal the following areas of irrigable land exist:—

	Acres.
High land	830,000
Ravi low land	490,000
Beas (or Sutlej) low land	260,000

Or about one and a half million acres.

No doubt this land should be irrigated, but how?

15. *The Lower B. D. Canal Scheme.*—A scheme has been prepared for the irrigation of this plot from the combined Sutlej and Beas rivers, taking off near Ferozepore. This project has been submitted by the Punjab Government to the Government of India, and though not yet approved by the latter, it seems likely to be approved after some modification.

It is, however, pointed out that there is surplus water in the north-west of the province, more than enough for all possible requirements in the Punjab and Sind combined, some of which must, therefore, be wasted perpetually; also that the eastern and south parts of the province are very dry and destitute of water. It is, therefore, strongly urged that to water the plot in question from the Sutlej is a great mistake, which will be greatly rued in the future if carried out, for it is a retrograde step.³

It is admitted that it is an easier scheme to irrigate this land from the Sutlej, and also that there are difficulties in the alternative scheme. Nevertheless, the ultimate benefits to the country as a whole by the alternative scheme are so much greater than by the scheme as prepared, while the difficulties are far from insuperable, so the Sutlej should certainly not be drawn upon for this project. Let us look at the matter a little more closely.

16. *Alternative scheme.*—The alternative scheme is as follows:—Make a channel from the Chenab river to the Ravi, and take out a canal from the Ravi to irrigate the lower Doab. Then, to make up the deficiency in the Chenab supply, make a channel from the Jhelum to the Chenab, and take out a channel from the Chenab to supply the lower part of the Chenab Canal. Agreed that over these big rivers are out of the question on account of the expense and the great height to which they would have to be raised to clear the floods, etc.; but the above method of dropping the water into the river and taking it out again presents no such difficulty.

17. *The objections.*—The main objections are two in number—

- (1) the great cost of crossing the drainages, and
- (2) the great height above the country of the Bari Doab, as compared with the bed of the Ravi.

³ The writer is informed that the Hon'ble Mr. Wilson, Settlement Commissioner, Punjab urged this same thing before the Finance Commission.

It is submitted that these objections are not of great weight, if only the best method of designing the project be adopted.

First, as regards a canal from the Ravi for the Bari Doab, Mr. Preston, speaking at the Society of Arts, spoke of the difference of level between the Ravi bed and the plateau as probably 40 feet.† The writer is doubtful if it can be anything like as much, but granted for the sake of argument that it is so, still it will not invalidate the scheme.

In the first place, there is not the least need to begin to irrigate by the new scheme at the Lahore-Montgomery border. The present B. D. Canal, of course, ceases to irrigate there at present, and it is granted that there must be no hiatus in the irrigation; but there is no difficulty in extending the Bari Doab Canal irrigation further down. The high land is here very narrow (it is wider lower down), and it would be no great matter to carry the Bari Doab Canal irrigation to the town of Montgomery itself, if need be. It would mean less than 100,000 more acres of annual irrigation.

Now the average irrigated area on this canal from 1886-87 to 1890-91 was 491,000 acres, and from 1896-97 to 1900-01 it was 746,000, or an increase of over 250,000 acres.

There will be no difficulty, therefore, in improving (enlarging the canal if need be) and extending to the extent stated, even if, in addition, an extra area is taken up in the Lahore district. Put the local officers on their mettle, and it is guaranteed that this will soon be done, without any injustice to the present irrigators.

Now the lower down the Doab the new canal has to begin irrigating the less the difficulty will be.

Suppose the new canal head in the Ravi were somewhere near the tail of the Vahu Escape, then such is the slope of the country towards Multan that the canal would doubtless be able to irrigate by the time it reached the town of Montgomery, which is all that is necessary, and this part of the scheme would not be costly.

18. *The Chenab to Ravi Channel.*—Now as to the channel from the Chenab to the Ravi, all that will be necessary will be to pass the 3,000 cusecs ‡ or thereabouts down the main line of the Chenab Canal, then along the Gogaira Branch till it reaches a point opposite the point on the Ravi where that river must be reached, and then make for that point by the shortest route which the circumstances will allow.

As to the main line of the Chenab, nothing whatever is required as 3,000 cusecs will be added on, and 3,000 will be also cut off by the new channels which bring in the Jhelum water.

The Gogaira Branch will have to be enlarged to carry the extra 3,000 cusecs (less the volume required for the irrigation at the tail which will be supplied by the new channel, i.e., if the new channel did not stop short of the Gogaira Branch). The absolutely new channel from, say, Bhabiano on the Gogaira Branch to the Ravi, will only be 20 miles or so long.

In crossing this low land doubtless some drainages will have to be negotiated, but by going low down the Ravi like this the chief difficulty will be avoided. To enter the Ravi opposite Lahore would be very costly; to enter it near Saidwala would be to escape all difficulties of drainage; to enter it at the point suggested would not be costly. The greater part, if not the whole, of the drainage met with would be diverted into the Ravi by a large catch-water drain and an embankment behind it to protect the new channel. The small amount of drainage which could not be so dealt with could be made to cross the channel by level-crossings where the levels suited, and by siphons where they did not. This could easily be determined by running a trial line in the direction suggested.

19. *The Jhelum to Chenab channel and continuation.*—This channel to carry, say, 3,000 cusecs, would either be the Jhelum Canal main line and Southern Branch enlarged, or else a separate channel close alongside these channels till it reaches the first great bend on the Southern Branch whence to the Chenab is a short distance of 15 miles or so. There would be very little drainage to be encountered. The big drainages would all have joined the Chenab up stream of this.

At the junction of this channel with the Chenab another weir would have to be built and a channel be made from that place to take up the irrigation of the Jhang, the Rakh

† Unfortunately the map at hand, which was furnished by the Punjab Irrigation Department, lacks levels which would settle this point.

‡ Cusec is a contraction in common use in India for one cubic foot per second.

sibly of the Gugaira) Branches below the points at which it cut the existing channels. This would, of course, cross the drainage of the country, but would not meet anything very formidable.

20. *Comparison of cost.*—It is not easy to make any comparison of cost between the scheme now before Government (say, Scheme No. 1), and that herein proposed (say, Scheme No. 2), but the following remarks may be considered.

As to the cost of Scheme No. 1, not only should the amount of the proposed project, i.e., Rs. 3,32,00,000 be included, but also the capitalized value of the Sutlej river water. The reason for this is that in Scheme No. 1 this water is used up for the lower Bari Doab, whereas in Scheme No. 2 other water which, as has been before shown, must otherwise be utterly wasted in perpetuity, is to be used for this purpose, and the Sutlej water set free to water land which is now desert and will remain desert on the lines of Scheme No. 1, but can be made most fertile by means of Scheme No. 2—a tract now worth almost nothing, but with a canal to water even one million acres would be worth at least Rs. 10,00,00,000; and the canal could irrigate immensely more than this.

21. *Rough estimate easily made.*—It is, therefore, strongly urged that a rough estimate of cost of Scheme No. 2 be prepared. This can easily be done without sending any European officer into the field by making each of the Superintending Engineers of the Jhelum, Chenab and B. D. Canals do the part in his circle (mainly from existing surveys and the cost of somewhat similar works in the circles). The very few trial lines which are needed for this estimate can be run by native surveyors in a month, and the rough estimate would be ready in three. If further surveys later on revealed possible improvements in the trial lines, then this would all be to the advantage of Scheme No. 2.

The different parts of the estimate would be as follows:—

JHELM CIRCLE.

(1) A channel from the Jhelum to the Chenab to carry 3,000 cusecs on the lines stated above.

CHENAB CIRCLE.

(2) A weir across the Chenab river at junction of above channel with the Chenab.

(3) A channel therefrom to take up the lower irrigation of the Jhang and Rakh Branches, and, if necessary, that of the Gugaira Branch also.

(4) An enlargement of the Gugaira Branch to carry 3,000 cusecs more, as far, say, as Bachiana, and a channel from there to the Ravi.

B. D. CIRCLE.

(5) Extension of B. D. Canal irrigation to Montgomery Town, including any necessary enlargement of channels.

(6) A canal from the Ravi where the Chenab channel comes in to take up the irrigation of the high land of the Bari Doab below the town of Montgomery and also the Ravi low land which is commanded.

All the new estimating required will be for the Ravi weir and the new channel from the Ravi till it meets the proposed alignment near Montgomery.

The estimate thus obtained will give a fair idea of the cost, and even if it cost 600 lakhs, it would be far better to spend this amount than to waste the beautiful water of the Sutlej on a tract which can get water elsewhere, instead of using it to enrich desert lands desolate for lack of water. As a matter of fact, Scheme No. 2 will not cost anything like this; it is far more likely that 400 to 450 lakhs will suffice for it. But let these two schemes be regarded not as mere isolated independent projects, but as part of a great whole for the improvement of the Province. It is believed, then, that No. 2 will undoubtedly be preferred.

22. *Another difficulty.*—If, however, Scheme No. 2 should be approved, what would be done with the water of the Sutlej thus saved?

This leads us to another difficulty. There is, undoubtedly, land available on the left bank of the Sutlej, but only a very small proportion of it is in British territory. Some of it would be in the Bikanir State, but the mass would be in the Bahawalpur State.

This is a drawback, but on the principle of developing the whole country it should be accepted that these lands should

obtain the water. Nevertheless, it is most important that certain conditions should be laid down and adhered to in the matter, as the ground upon which alone the British Government will consent to forego the use of the water of the Sutlej on the right bank thereof, and put itself to great extra expense in so doing.

Canals partly worked by the Native States present intolerable difficulties, only to be realised by those who, like the writer, have experienced them.

Therefore the following conditions should be insisted on:—

(1) The canal to be British, and constructed with British capital only, and worked and maintained by the British, just as the Abohar and Bhattinda Branches of the Sirhind Canal are worked.

(2) The British Government to fix the rates to be charged as it thinks fit.

(These rates will be doubtless higher than on the Sirhind Canal, seeing the immense value of the water in such a rainless tract, and the great cost involved by this scheme, and the other schemes necessitated by this one.)

(3) Proper arrangements to be made on a plan worked out by the British Government for supplying the necessary population for the cultivation of the land which will be irrigated, but which is now nearly uninhabited.

The Native States will gladly consent to these terms if they understand that only thus can they get the water, and no matter what is done, or however high the rates fixed may be, the gain to the States, especially to Bahawalpur, will be stupendous, just as the gain has been to Faridkot through the Sirhind Canal.

Of course the weir across the Sutlej would make a provision for the supply of the inundation canals on the right bank, which are supplied at present from that river. The objection to the use of the Sutlej water to the high land on right bank would not apply to this low land, for those canals will only require water when there is extra water in the river.

As to the proposed canal on the left bank, it should be designed to command five million acres, for it will be able to irrigate nearly two million acres, and there should be room for expansion as the duties of the water are improved. It may, however, possibly be better to make two or more smaller canals instead of one huge one. Almost all the land embraced by such schemes is now practically desert land.

23. *The Sirhind Canal.*—As regards the Sirhind Canal, it gives the fullest protection to its commanded area, viz., to the Ludhiana and Ferozepore districts, and the main portions of the Patiala, Jhind, Nabha, and Faridkot States.

Unfortunately the canal partly belongs to the Native States, and this causes complications, otherwise it would be proposed to extend the irrigation from the Kotla and Ghaggar Branches into the Sirsa Tehsil of the Hissar District, but apparently the treaties with the States prevent this being done, which is a pity.

24. *The country between the Ghaggar and Jumna.*—The Sirhind Canal irrigates up to the edge of the Ghaggar river, and we will now consider the case of the country between the Ghaggar and the Jumna. It is this tract which contains almost the whole of Punjab, which is subject to famines, and the amelioration of its condition is perhaps the most urgent question of all.

The Western Jumna Canal irrigates much of this tract and is invaluable. But even with this canal there is a great deal that is sadly needed for the improvement of this part of the country, and many difficult problems have to be solved.

The tract in question embraces the six districts of Ambala, Karnal, Delhi, Gurgaon, Rohtak, and Hissar, and parts of Patiala, Jhind, and Nabha States.

Its first desideratum is that it should be secured against famine; the second that its general conditions should be improved.

The Ambala district has the best rainfall and many wells, and is already secured; therefore nothing need be said about it, except that what will be said with regard to the torrents in dealing with the Karnal district will apply in measure to Ambala.

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Jacob.

The Delhi district is so well irrigated by the W. J. Canal, besides having a better rainfall than the rest, that it, too, may be looked at as secure.

25. *Gurgaon district*.—The Gurgaon district must be treated by itself. It cannot be dealt with from the outside.

It has already a system of rough but fairly effective irrigation works belonging to the district. What is wanted is that this system should be much improved and extended, and money should be freely furnished for this purpose. It should not be expected that these works will furnish a large return for the expenditure, and the district has not capital enough for the purpose.

Mr. MaGregor, the District Engineer, is fully capable of drawing up a thorough scheme for the protection and prosperity of the district, and with the help of a subsidy from Government, and money lent on easy terms, this district can be thoroughly secured, and made to flourish in a high degree.

26. *W. J. Canal*.—For the rest we must look mainly to the Western Jumna Canal.

This canal has a horribly chequered history, and, while the oldest, it is far the most backward of all the Punjab canals. It has been patched and repatched, a bit new here and a bit new there, but always tacked on to the old, and therefore never what it should be. This old canal of the Moghls had every defect a canal could have, and though vastly improved, is very different to a properly constructed and designed canal. The Government system of accounts hits this canal very hard. The nominal capital account is about 180 lakhs of rupees, though half the canal is still in its primitive condition. The cost of, say, patches No. 1, No. 2 and No. 3, is all charged to the canal capital, though Nos. 1 and 2 have long been superseded; and a brand new canal could have been made for the amount of the present capital. Any commercial business would have carried out the improvements by means of a sinking fund or redeemable debentures, and left the capital small. Even now it would be far better for a large portion of the capital to be written off against surplus profits, which were so large in the old days, going back, say, about 50 years, and altering the accounts accordingly.*

It may be said that it is only a question of accounts, and it does not matter. But it does matter, for the overloading of the capital account has a bad effect on the improvement of the canal.

27. *Peculiar conditions*.—What adds to the difficulty of the problems connected with this canal is that the seasons are so unequal at different periods. Thus, from 1870-71 to 1891-92, a period of 25 years, there were only two very dry years, viz., 1877-78 and 1883-84, and very few even fairly dry ones. Most of the years were wet; that is, over the area embraced by the old unextended canal.

Since then there have been seven years of drought or famine, occurring one after the other. This greatly increases the difficulty of dealing with the circumstances. In the first half of the last decade (1893-1900) the cry went up all over the canal—"We do not want your water; we only want drains." In the latter half—"Why these drains? We only want water."

Unfortunately the last extensions were only just being carried out when the drought began. Had they been finished a few years before the drought, the irrigation would automatically have shifted its centre from the wetter tracts traversed by the old canal, where year after year the demand for water was so slight, to the new and drier tracts of the extensions. If after that the drought had occurred, the relief at famine time would have been far greater than it was (though the famine would have been very much worse but for these extensions).

28. *Hissar district*.—The famine fell with far the greatest severity on the large Hissar district (as big as Yorkshire), where the distress was greater than in all the rest of the Punjab put together.

This district has five tehsils, and there is some irrigation in all of them, but irrigation from the late extensions at the tail of the Sirsa Branch, from the Hansi Branch, and from the Bhiwani distributary, were not fully developed, for the reason given above, for, owing to the great demand for water on the one hand and the frequent cutting of the banks on the other (this was worst on the

Bhiwani distributary), it was very difficult to get water to the tails. No doubt something is being done now in this direction, but directly the old order of seasons returns, it will be possible to work up these extensions to a thorough state of efficiency and bring out their full value. Besides this, it is necessary that the rest of the land under command in the Hissar district (leaving out that part which is altogether too sandy) should also be taken up for irrigation. This area is not vast, but if it is irrigated and the former extensions fully developed, there can be no famine in Hissar and no great scarcity. The situation would be saved.

The chief unirrigated and irrigable tract is the one which would have to be reached through the Jhind territory from the Batana Branch, which must be enlarged. On no account, however, should this distributary be made until the Jhind Darbar consents to the condition that it should be wholly a British channel and all the irrigation be looked after by British officials, and a consolidated rate be charged for the water, equal to the combined rates paid on British territory.

Even on these conditions the benefit to the State would be so very great that directly it is seen by the darbar that it must accept the conditions or the channel will not be made, immediate consent will be given. These conditions are those made with Faridkot on the Sirhind Canal. On no account should any other arrangement be made with the Jhind or any other State, such as the former one made on the W. J. Canal, which makes the proper working of the canal impossible. It is like trying to walk fast with a stiff knee cap. It was all right in old days when there was more water than could be used; it is an anomaly and a blot in these days of economy of water.

There is some other land to the south of the new Patwar distributary which should be taken up, and this would appear to be all, except an important part of the Hissar district near Barwala, between the Patwa and Mahendpur distributaries, but unfortunately this cannot be irrigated without upsetting the arrangements with the Patiala State as to irrigation from the Sirsa Branch. These territorial arrangements are heart-breaking, and canals should be like railways, independent of these differences.

The canal officers should be encouraged to work up the irrigation in Hissar to the utmost. It is much easier to irrigate near the heads of channels than at the tails, especially when, as here, the channels are very long, but it is essential that the water should be pushed down to the extremities. The Bhiwani Tehsil of the Hissar district has practically had no irrigation as yet from the Bhiwani distributary.

Every bit of the Hissar district which can be commanded, and is not altogether too sandy, should be irrigated and get its share of water, whether from the W. J. Canal or otherwise. Some of these other portions of the district will be mentioned later, and the question of how this can best be done will be discussed.

29. *Rohtak district*.—The Rohtak district is perhaps the next worst district to Hissar, though after a long interval.

The Gohnna Tehsil is well irrigated. The Sampla and Rohtak Tehsils are both irrigated, and when the irrigation on the Bhalot and Bhiwani distributaries, especially the latter, is developed, then these two tehsils will also be secured, and the Jhajjar Tehsil will be the only one left to be troubled with famine.

This is not an easy matter to remedy. The land is almost all too high to be watered by the canal. The writer has not sufficient local knowledge to say how this problem can best be solved, but probably it can be done in connection with the drainage which runs into the Najafgarh Null, including drain No. 8. Lack of knowledge of details precludes more being said, but with the rest of the district secured, scarcity in the Jhajjar Tehsil cannot be bad, but certainly remedial measures are possible here also.

30. *Native States in South-East Punjab*.—There are portions of the Patiala, Jhind, and Nabha States in the extreme south-east corner of the Punjab. These suffered greatly in the recent famines. The country here is very like that of the Gurgaon district alongside, and it can be treated in just the same way by local irrigation works and the damming up of torrents.

31. *Karnal district*.—The greater part of the Karnal district is thoroughly protected by the W. J. Canal. Some portions of the distributary system, especially the Nardak distributary and Chautang scheme, need developing, like

* It is on this same principle that a Government building is supposed to get more and more valuable the older it gets, and the higher is the rent charged for it. A remarkable instance of this was the head-quarter bungalow of the Karnal division at Dadapur, just before the transfer of the divisional office to Karnal. This bungalow, when so old and rotten that it hardly held together and leaked like a sieve, was charged for at a higher rate than ever before.

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those in Hissar, but when this is done, the greater part of Karnal will be quite raised above fear even of scarcity.

The other part outside the scope of the W. J. Canal proper will be separately considered.

82. *Suggestions as to arrangements for the above proposals.*—It will naturally be enquired whence the water is to come from to carry out the above.

It is not proposed to attempt a final answer to this question, but some suggestions as to the way in which the solution can be gained may be mentioned.

Unfortunately the Jumna River does not lend itself to canal extension as well as the other Panjab rivers, for it rises more tardily in the spring (a great defect), and generally falls more quickly in the autumn. Therefore, while something might be gained by carrying larger supplies when available, yet the gain would be less than on other canals.

The first thing to be done is to improve all the internal arrangements. Much, very much, has been done, and is being done, but much remains to be done. The old irrigators are the worst offenders. Their water-courses must be made straight, and must be well kept, and the land must be divided up into the proper plots (kharis). The cumbersome and troublesome rules on the subject must be amended, and it must be made clear to everyone concerned that the necessary divisions must be made, or the water will be cut off. The question is of such importance that it must be approached in a thorough and systematic manner with insistence. The water saved by this reformation will be a distinct step to the gaining of the end in view. Together with this, the standard of maintenance must be raised still higher, the channels be better kept even than now, and the expense of this high standard must not be grudged. It must be borne in mind that on a defective canal like this the cost of maintenance must be much higher than on well-designed canals.*

With the above there should be a great rise in the rates for sugarcane. It is the waterings for the cane which so stand in the way of the developments imperiously needed.

The combined rates for sugarcane should be raised from Rs. 9 per acre, as at present, to at least Rs. 18. The result will then either be that little cane will be grown, in which case the problem would be solved at once (there would be ample water for all that is wanted), or else, and this is far more likely, the area of cane will be much less before (this is the conclusion come to after careful enquiry), but the revenue will be increased by four or five lakhs of rupees per annum, and this, though not so efficacious as the alternative, would go far towards solving the question in other ways.

It must be remembered that until the recent drought occurred, much land of the Delhi and Karnal districts suffered from over-irrigation. These parts were under medical supervision because of their unhealthiness. The spring level was very high, less than ten feet from the surface, and the land was impoverished. This was in spite of the marked improvement effected by the drainage schemes before alluded to.

The extension of the canal on the one hand and the seven years' drought on the other have been the greatest blessing to these over-irrigated parts. They could not get the same water as before because of the great demand, and much less ruin fell. The consequence is that these parts have marvellously improved in tone, in health, and fertility by the very cause which brought much suffering elsewhere. The spring level, too, though still very high, has fallen.

It is to be hoped that this improvement will be maintained and even increased, and that on no account will these tracts be allowed to revert to their old condition. The people here should pay well for the water, especially for the cane, and pressure should be put on the people to irrigate by wells where the spring level is less than 15 feet from the surface. The amount of irrigation allowed in such tracts should be strictly limited, and it should not be allowed at all where the level is within 10 feet of the surface.

Thus the reproach caused by the unhealthiness brought about by the irrigation of this canal would be completely wiped out, while the water saved would go to enrich tracts which so much need it.

83. *Further suggestions.*—It is believed that by the above methods there will be no difficulty experienced in

getting sufficient water to completely develop all the later extensions on the W. J. Canal, and also to irrigate all the tracts still unirrigated, but potentially commanded by this canal.

Then famine should be for the Panjab a thing of the past, and a measure of scarcity over a very reduced area be the worst to be feared.

It should be insisted on that the matter be fully taken in hand at once, as one of the deepest importances. Prevention is much better than cure.

Once it is understood that the thing must be done, impossibilities will vanish.

If, however, it be still urged that there is no water which is really a valid plea, then another suggestion is put forth as follows:—

There is a most rapid fall between Tajawala and Dadapur at the head of this canal, and any required amount of power is available.

The canal, in its upper reaches especially, passes through a water-logged spongy soil, saturated with water, which in places, as above Indri, comes to the very surface of the ground.

There is no engineering difficulty in converting the power into electricity, and pumping up the water from the saturated soil and adding several hundred cubic feet a second to the discharge of the canal, if need be, and returning the water to the soil in the flood season to be again pumped up.

This scheme would, however, be very costly, especially because of this, that there would be so many years normally wet, when extra water would not be required. The scheme is merely put forth as an alternative in case the first suggestions (which the writer is assured are all that is needed) are objected to.

The great thing is to get the water to the parts which need it so much, instead of lavishing it where but little needed and even where it may do harm. Once the normal character of the seasons is reverted to all will come right as to the widest extensions, if the canal be properly worked.

84. *A lost opportunity.*—What a splendid opportunity was lost when the W. J. Canal was remodelled in the seventies to have taken up the whole commanded area in a thorough manner!† Such an opportunity can never come again, and the canal must now be a makeshift with many bad mistakes to the end of the chapter, but the minor extensions here proposed in addition to the major ones that have been carried out in the last ten years or so will do much to wipe out the reproach of the past and completely change the old order of things, in which the parts which wanted the water least got the most, and those which wanted it most got none.

85. *The tract between the W. J. irrigation and the Ghoggar.*—There is still one more tract of land to be discussed, and that is the tract between the Western Jumna irrigated area and the Ghoggar, including the tract at the lower part of the Ghoggar, where the Ghoggar canals are situated.

This is a tract sited in its upper portion by great torrents, which all eventually unite and find their way into the Ghoggar River. This tract is not in a flourishing condition. It is sometimes inundated and at other times suffers from drought.

The torrents have often been obstructed in a most unscientific way for rude irrigation, with the result of injured health, blocked drainages, and general impoverishment of the country.

What is wanted is a clear water-way for the floods, and some arrangement for supplementing the water-supply in times of drought.

In this portion are the Sarnati District Canal (Karnal), the Rangoi District Canal (Hissar), the Ghoggar Canals (Imperial). None of these have worked to any extent in these late years of drought, and this bit of country waits thorough consideration.

It is believed that it is possible to put this tract into thoroughly good order, but it will be expensive, and the scheme must not be expected to be remunerative in a pecuniary sense, but indirectly it will be very advantageous and remunerative.

† Doubtless the importance of the question is the broadest sense was not understood, but the Irrigation Department would have done the work in a far more thorough manner had its officers been allowed to do it or they wished.

* This is another argument for the reduction of the capital cost of this canal, which has before been alluded to.

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36. *Proposals*.—All obstructions should be taken from the torrents. If irrigation is to be done from them at all, it should be by means of proper channels taking out above properly constructed but cheap regulators, under the control of those who will work them properly, and the channels must be re-dug where blocked, and parts must be straightened.

The Sarasti Canal is a thoroughly sound one in its conception, but it was marred for lack of funds. Even as it is, it will work fairly well in normal years, but it will fail in bad years like the recent ones.

What is wanted is an embankment at the lower end of the lake from which the canal takes out, with a masonry regulator (a needle weir perhaps the best) in the centre of it, so that the lake may be much enlarged and deepened, and the canal made much more efficient. This will be a great improvement, and the canal be much more workable.

It can, however, be still further improved. There are at least three months in the year in which there is spare water in the Jumna river.

There is a torrent just above Dadapur, into which spare water can be forced, and this water will then, partly by existing channels enlarged, and partly by new cuts, combined with suitable regulators, find its way into the Sarasti torrent, and feed the lake from which the Sarasti Canal takes off (a part being taken if needed for the Chantang scheme).

Three months' supply can be counted on, and this is sufficient to make these canals work fairly (with less they can do but little, and only grow a very coarse rice), and if in the Karnal district irrigation wells were also constructed to work with the canals, as is done on tracts irrigated by inundation canals in general, this tract would be most flourishing. Also it will then be possible for the canal to be prolonged through a barren part of the Patiala State into the Hissar district near Tahana, and water a very needy portion of the Patiala Tehsil, viz., that between the Sirsa Branch and the Rangui Canal, and it would thus be invaluable for the famine protection of Hissar.

Let it be made a rough approximation that the Sarasti Canal be enlarged to carry 1,200 cusecs, of which 350 be used in Hissar, 200 in Patiala, and 450 in Karnal, the rest being absorbed. This would thoroughly secure this tract, which needs a double treatment, viz., proper control of the torrents and water for times of drought.

The channel out of the head channel above Dadapur could be made to carry 2,000 to 2,200 cusecs; the surplus would be carried on through the outfall below the head of the Sarasti Canal into the Ghaggar River, and by means thereof the Ghaggar Canals would be able to work satisfactorily, and the Rangui Canal prospects would be secured. These canals all irrigate the thirsty Hissar district, and will thus do much to raise it above all scarcity.

37. *Further proposals*.—This scheme would not be directly remunerative, but it would be of great service. It is one which in its design and construction, and also in its maintenance, should be entirely in the hands of the Irrigation Department, for, if badly designed or worked, it would do great damage. The two railways also which are crossed would require assurance as to the maximum volumes of water they might have passing their lines; they will, doubtless, need to strengthen their bridges, and to be repaid for doing so. Proper regulations would be required to ensure correct working, and great promptness would also be needed to shut off all extra water when the torrents were flowing full. Then, again, as the canal would water two districts and a Native State, therefore district authorities would not be able to work it.

N.B.—The whole canal should be under one management only, not partly British, partly Native State. This latter arrangement is fatal to all good work, economy of maintenance, and efficiency of every kind.

38. *Completion of the sketch*.—This completes the sketch of the requirements of the Punjab (and Sind), with a view to the best use of the available water-supply, the prosperity of the province as a whole, the prevention of famine, and even of scarcity.

Before ending, however, it is desired to call attention to three matters of great importance.

39. *Maintenance of canals*.—The question of the maintenance of canals has been mentioned in connection with the Western Jumna Canal, but everywhere, greatly as the standard of maintenance has risen of late years, there is the greatest need of raising it much higher.

It must be understood that to have every channel in perfect order is not a matter of any wash, but that it means economy of water. Every irregularity, every hole or unevenness, every unnecessary bend and twist, every unnecessary length in reaching any goal, means loss of water more valuable than gold.

Money for maintenance has been far too grudgingly accorded. Give money for this ungrudgingly. It will return doubled and trebled; and not only so, but the less the absorption the less the fear of injury to the soil. All Government channels must be beautifully kept, and the cultivators must be made to understand that they must keep theirs beautifully too. The old crooked water-courses must be relegated to the past; the old ones must be remodelled; the new ones must be aligned by competent officials, and properly dug from the start; the fields must be properly divided up according to the regulations, which, alas, have been but little observed, and thus, step by step, the old order brought nearer perfection.

40. *Differential rates*.—It will hardly be disputed by any who have a thorough knowledge of the subject that the returns obtained for the water used for irrigation are exceedingly inadequate.

This is seen by the extraordinary enhancement in the value of the land when it becomes irrigable. That the value should be enhanced is intelligible enough, and quite right, but the value is not only doubled and trebled, but sometimes twenty-fold what it was before.

It is often stated that the condition of the peasantry on the new canals is very satisfactory. This is true, but it is the condition of the peasantry in the unirrigated lands which should be more seen to, and the abundance of the holders of irrigated land should go in greater proportion than it does to the less fortunate, so that their lot may be ameliorated.

Some expensive and some unremunerative schemes have been mentioned as necessary, and there is every reason to urge why the fortunate possessors of land on permanent canals should bear the burden thereof.

The difficulty of getting adequate returns doubtless lies in the differences of the soil.

On the average the rates charged are considerably too low, but for some soils they are as much as can be borne, possibly too high in a few cases. On the other hand, there are soils and crops which could well pay vastly more than they do, and still make splendid returns.

It is suggested that the better kinds of produce might pay more in proportion to the poorer kinds; sugarcane pays absurdly low rates, while there might well be a greater difference between the rates for wheat and for barley than there is, and so on. The great desideratum, however, seems to be that just as there are differential rates for different classes of crops, so there should be for classes of soil.

As in the settlement of a district the various kinds of land are classified and revenue rates fixed accordingly, there would be no difficulty in arriving at the necessary conclusions to enable differential rates to be fixed.

Difficulties doubtless there would be, and possibly new legislation required, but it would be a great thing to overcome these difficulties and to get a return for the water supplied which would be a closer approximation of its real value than now obtains.

Who can doubt that if people were allowed to acquire rights in the water and to sell it, that they would charge far more (double or triple) than is charged now.

There was a case of this sort where a European, named Staines, acquired a water-course on the Western Jumna Canal near Rahtak, with certain rights, and for years he made large profits by selling the water at very high prices, and a large sum was eventually paid him as compensation for his loss (when he could no longer do this) by order of the Lieutenant-Governor.

41. *Establishment*.—One other matter will be mentioned, and that is the question of the establishment, and in a way it is the most important of all.

An officer giving evidence before the Famine Commission asked to be allowed to speak on this point, but was told it was barred by the constitution of the Commission. Nevertheless an Irrigation Department in the highest possible state of efficiency is the best possible preventive against famine.

* This is not an original idea, but it is a very good one.

Work up the Irrigation Department, give to it much larger scope than at present, throw the onus of preventing famine on the officers thereof, let this be looked at as a chief duty of the department, and it will do more than anything else to avert famine.

The Irrigation Department has vastly expended of late years, and must expand much more, but the establishment of the Irrigation Department has been little cared for, discontent rules, and the Service is most unpopular. This can easily be proved. Ask for volunteers from the Irrigation Department for the Railways or for the Buildings and Roads Branch, and many will respond at once. Ask for volunteers from the Railways or B. & R. Branch for Irrigation, and not one will come forward. This is not a theory; it is a fact, for it has been tried.

This ought not to be. There is nothing material that can benefit India as much as irrigation, and there is no branch of Engineering which presents so many difficulties and contains so many problems to be solved.

Moreover, there is one matter in this connection which has not received sufficient attention. This is as follows:—In other branches of engineering the Indian Engineers enter into the labours of myriads of European engineers, who are over engaged in solving the various difficulties that arise, but in Irrigation the Engineers are Pioneers, having to work out their own problems, and others enter into their labours, as in the case of Egypt.

Surely this is reason enough for seeking the highest class of men for this work—men who are observant, who, not content just to plod along, carefully study the various difficult problems which meet them in their work, full of enthusiasm, who understand that there are immense possibilities in this field if the subject be mastered.

To get men of this class, it is worth while to pay highly, and nothing is more costly than to get inferior men for such complicated and delicate work as this is.

Entry into the department should be looked at as a prize; and when officers prefer, as they do, the matter of foot Buildings and Roads Branch to the Irrigation Branch with its fascinating problems, it shows that there is something wrong.

It is not meant that there are not able men in the department; there are several who could be named of very high ability, while the department, as a whole, is extremely hard working, being in a way forced into hard work, because in the lonely life led there is so little else to do. Nevertheless the present method pursued is not the way to secure men up to the required standard. The loneliness, the laborious character of the work, and the fact that he who would excel therein must cut himself off from the pleasures of society, and spend most of his time in camp, hot weather and cold, in a way which is not at all necessary with other engineers, should be borne in mind.

The jungle allowance was a step in the right direction, but a more generous treatment by far is necessary if the department is to recruit and maintain the high standard of efficiency which is so desirable.

When, particularly, we look at the officers on whom so much of the burden of the work falls, i.e., on the sub-divisional officers—what do we see? A most heterogeneous mass. Imperial engineers; provincial engineers; temporary engineers, picked up anyhow and treated as aliens; subordinates of all sorts; and even zilladars holding sub-divisions. The confusion is terrible. How can a proper standard be gained under these circumstances? The matter has been reported and referred by the Local Government often enough, but no real reformation has been attempted.

The matter needs to be taken up thoroughly. The Irrigation Department wants to be treated in a most generous manner in accordance with the exigencies of the case as a department "*enri generis*," just as the railways are

treated; and as Irrigation officers labour under so many disadvantages in some ways which cannot be remedied, these should be made up to them by extra pay and increased advantages in other directions as a compensation, so that entry into the department may be as much desired as now it is dreaded.

It is earnestly hoped, however, that no such remedy will be proposed as to make the irrigation officials simply engineers, while all the rest of the work is done by revenue officials. This would be to damage the department more than anything else could do. It would take all the brunt out of the engineers. They would no longer be able to work for results as they now do. The engineering work would sink into dry routine, and the many complicated problems which now engage the minds of the thoughtful among them would no longer engage their attention. There are undoubted defects, but this certainly is not the remedy.

The higher revenue officials engaged in the work would never make this work their life study as the engineer has to do. It would merely be an episode of many in their lives. The Civil Servant would take it up no doubt in good earnest and do his best, but the post would only be a stepping-stone to a higher appointment of a different kind. How could he take up the questions involved as those do who have but this one matter to engage their attention. It is not a question of the ability of the two classes, but of whether efficiency can be obtained on any subject by men who can give but minor attention to that subject.

42. *Summary.*—It now remains to give a brief summary of the contents of this paper:—

- (1) Let the possibilities of the future be read in the light of the progress in the past.
- (2) Let there be greater boldness in attacking the problems to be solved, and let these be taken up in a broader manner than has yet been done.
- (3) Inundation cannot most be supplied from weirs; navigation must not be considered.
- (4) Use every drop of available water as far as possible, even if cheaper schemes can be designed which entail waste of water.
- (5) Every bit of land which needs water to be irrigated if possible, even if the schemes be costly.
- (6) Famine to be looked at as a blot and anomaly, and thoroughly combatted, money being freely given even to unremunerative schemes for this purpose.
- (7) The Indus water to be more fully utilized in Sind as well as in the Panjab.
- (8) The Jhelum, Chenab, and Ravi water to irrigate up to the right bank of the Sutlej (except the Sutlej low lands).
- (9) The Beas-om-Sutlej water to be utilized on the left bank thereof.
- (10) The tract between the Ghaggar and the Jumna to be more fully irrigated, each part being dealt with on its own merits. No tracts commanded by the W. J. Canal to be left without irrigation.
- (11) A higher standard of maintenance to be adopted and more money spent thereon.
- (12) Differential rates for soils to be adopted, as well as higher rates for high class crops.
- (13) The establishment to be remodelled and dealt with more economically, as for a department by itself.

43. *Final remark.*—It is believed that the proposals made herein will not only conduce to the better development of the Province as a whole than anything yet proposed, but that they will even be the best in direct pecuniary results, taking these over a series of 30 or 40 years.

Col. S. L. Jacob.

(36) *Questions for Revenue Officers including Officers of the Public Works Department who have had experience of the administration of water-supply.*

N.B.—Officers are requested to answer those questions only regarding which they can give information from personal knowledge, or from authentic source.

A.—General.

1. To what districts or tract do the answers below refer? What opportunities have you enjoyed of becoming acquainted with it?

2. What is the average rainfall in each month of the year?

Punjab

3. Is there any obstacle to the extension of irrigation arising from—

- (1) sparsity of population?
- (2) insufficient supply of cattle suited to the cultivation of irrigated land?
- (3) insufficient supply of manure?

- (4) unsuitability of soil (e.g., black cotton soil) to irrigation?
- (5) uncertainty of the supply of water or its too late commencement or too early cessation?
- (6) lack of capital for the initial expenditure or of funds for the more expensive cultivation of irrigated crops?
- (7) fear of enhanced rent or revenue assessment?
- (8) uncertainty of tenure or defects of the Tenancy Law?
- (9) other reasons?

4. For what period, if any, is land which is irrigated from works constructed by private capital exempted from enhancement of assessment on account of the irrigation? How is the exemption secured in practice? Is any similar exemption from enhancement of rent extended to tenants who have extended irrigation to their holdings at their own cost? Do you consider that the existing provisions in this respect are sufficiently liberal? If not, what alterations would you suggest?

5. Are loans under the Land Improvement Act freely taken by the people for the extension of irrigation? If not, why not, and what measures would you suggest for the encouragement of these loans? Would you recommend—

- (1) reduction of the rate of interest?
- (2) remission of the interest?
- (3) partial remission of the advance?
- (4) total remission in case of failure of the attempt to obtain water?
- (5) extension of the period of repayment?
- (6) grants-in-aid?

6. Does the extension of irrigation tend to injure the remaining cultivation by attracting its cultivators to the irrigated tracts?

Can you give any instance of this which has come to your knowledge? Is there any strong desire evinced among the people of your district to have means of irrigation extended to it or increased?

B.—Canals of continuous flow.

7. To what extent does the irrigation increase the value of the produce of land—

- (1) by rendering it possible to cultivate two harvests instead of one?
- (2) by leading to the substitution of more for less valuable crops or varieties?
- (3) by increasing the yield—
 - (a) in a year of ample rainfall?
 - (b) in a year of scanty rainfall?
 - (c) in a year of drought?

8. Can you give an approximate estimate of the increase in the total annual value of the produce per acre due to the irrigation—

- (1) on the average of a normal term of years?
- (2) in a year of drought?

9. What is approximately the average annual rate per acre paid on account of irrigation—

- (1) by the cultivator (or the owner?) of the land to the owner of the canal in the form of water-rate or otherwise?
- (2) by the cultivator to the owner of the land in the form of enhancement of rent or otherwise?
- (3) by the owner of the land to the Government in the form of enhancement of revenue, water advantage rate, owner's rate or otherwise?

In each case please state whether the rate is paid on the area actually irrigated during the year, on the area ordinarily irrigated, on the whole irrigable area, on the total area of the holding, or how.

10. What, if any, private expenditure is necessary to bring the water to the field or to prepare the land for irrigation? Is this generally incurred by the landlord or by the tenant? If by the latter, what security has he for reclamation?

11. Has any damage resulted to the people or deterioration to the soil from irrigation without manure, from too profuse, too extensive, or too frequent irrigation, from water-logging, salt efflorescence or otherwise? If so, what is its form, its extent, and, in your opinion, its cause and the possible remedy? Of what standing respectively are the irrigation in question and the evil which has sprung from it? Is the latter increasing? What is your experience of the results of draining irrigated land?

C.—Canals of intermittent flow.

N.B.—Small irrigation channels, supplied by temporary dams thrown across a river-bed, are included under this heading.

12. Please describe generally—

- (1) the manner in which the _____ canal (or group of canals) in the _____ district is supplied with water;
- (2) the manner in which the water is distributed to the land;
- (3) the period for which the supply is ordinarily maintained—
 - (a) in a year of ample rainfall;
 - (b) in a year of scanty rainfall;
 - (c) in a year of drought.

13. To what extent does the irrigation increase the value of the produce of land—

- (1) by rendering it possible to cultivate two harvests instead of one?
- (2) by leading to the substitution of more for less valuable crops or varieties?
- (3) by increasing the yield—
 - (a) in a year of ample rainfall?
 - (b) in a year of scanty rainfall?
 - (c) in a year of drought?

14. How far is the value of the irrigation diminished by—

- (1) the too late commencement?
- (2) the too early cessation of the supply?

15. Is the irrigation ordinarily supplemented by irrigation from wells given to the same land and, if so, how far is this essential?

16. Can you give an approximate estimate of the increase in the total annual value of the produce per acre due to the irrigation—

- (1) on the average of a normal term of years?
- (2) in a year of drought?

17. What is approximately the average annual rate per acre paid on account of irrigation—

- (1) by the cultivator (or the owner?) of the land to the owner of the canal in the form of water-rate or otherwise?
- (2) by the cultivator to the owner of the land in the form of enhancement of rent or otherwise?
- (3) by the owner of the land to the Government in the form of enhancement of revenue, water advantage rate, owner's rate or otherwise?
- (4) by the owners of the canal to the Government in the form of royalty?

In each case please state whether the rate is paid on the area actually irrigated during the year, on the area ordinarily irrigated, on the whole irrigable area, on the total area of the holding, or how.

18. What, if any, private expenditure is necessary to bring the water to the field or to prepare the land for irrigation? Is this generally incurred by the landlord or by the tenant? If by the latter, what security has he for reclamation?

19. Has any damage resulted to the people or deterioration to the soil from irrigation without manure, from too profuse, too extensive or too frequent irrigation, from water-logging, salt efflorescence or otherwise? If so, what is its form, its extent, and, in your opinion, its cause and the possible remedy? Of what standing respectively are the irrigation in question and the evil which has sprung from it? Is the latter increasing? What is your experience of the results of draining irrigated land?

20. How is the maintenance (repairs, silt clearance and the like) provided for, and what is the approximate annual cost per acre irrigated? Does the system work fairly well and is any legislation required?

21. Were any of the canals constructed by private persons? Has any trouble arisen in such cases in regard of the supply of water by the owners of the canal to other owners of land, or of the realisation of dues for the same? Has it been found necessary for Government to take over the management of any private canals, and if so, why?

22. Do you consider it advisable to encourage and assist the construction by private persons of further canals, and, if so, how could this best be done?

D.—Tanks.

23. Please describe generally—

- (1) the way in which the tanks in the _____ district are supplied with water;
- (2) the manner in which the water is distributed to or utilised upon the land;
- (3) the period for which the supply is ordinarily maintained—
 - (a) in a year of ample rainfall;
 - (b) in a year of scanty rainfall;
 - (c) in a year of drought.

(4) the area ordinarily irrigated from a tank.

24. To what extent does the irrigation increase the value of the produce of land—

- (1) by rendering it possible to cultivate two harvests instead of one?
- (2) by leading to the substitution of more for less valuable crops or varieties?
- (3) by increasing the yield—
 - (a) in a year of ample rainfall?
 - (b) in a year of scanty rainfall?
 - (c) in a year of drought?

25. How far is the value of the irrigation diminished by—

- (1) the too late commencement?
- (2) the too early cessation of the supply?

26. Is the irrigation ordinarily supplemented by irrigation from wells given to the same land and, if so, how far is this essential?

27. Can you give an approximate estimate of the increase in the total annual value of the produce per acre due to the irrigation—

- (1) on the average of a normal term of years?
- (2) in a year of drought?

28. What is approximately the average annual rate per acre paid on account of irrigation—

- (1) by the cultivator (or the owner) of the land to the owner of the canal in the form of water-rate or otherwise?
- (2) by the cultivator to the owner of the land in the form of enhancement of rent or otherwise?
- (3) by the owner of the land to the Government in the form of enhancement of revenue, water advance rate, owner's rate or otherwise?

In each case please state whether the rate is paid on the area actually irrigated during the year, on the area ordinarily irrigated, on the whole irrigable area, on the total area of the holding, or how.

29. What, if any, private expenditure is necessary to bring the water to the field in the proposed tank irrigation? Is this generally incurred by the landlord or by the tenant? If by the latter, what security has he for recoupment?

30. How is the maintenance (watching, repairs, silt clearance and the like) provided for? What is the approximate annual cost per acre irrigated? Does the system work fairly well and is any legislation required?

31. In the case of tanks constructed by a private person or persons, how is the distribution of water to the other owners of land regulated or arranged for? Has any trouble arisen in this respect or in connection with the realisation of water dues? If so, is Government assistance advisable and is any legislation required?

32. Do you consider it advisable to encourage and assist the construction by private persons of further tanks; and, if so, how could this best be done?

33. Is much inconvenience experienced from the liability of tanks to silt up? Can you give any statistics on regards the depth of silt accumulation per annum? Is it the custom to remove the silt by dredging or otherwise? If not, what steps are taken to prevent the ultimate silting up of the whole tank?

E.—Wells.

34. Please state generally for each of the main tracts into which the _____ district is divided—

- (1) the average depth of permanent wells;
 - (2) the nature of the supply, whether from springs or from percolation, and whether liable to fail or become too saline to use—
 - (a) in an ordinary year;
 - (b) in a year of drought;
 - (3) the average cost of construction;
 - (4) the average duration of a well;
 - (5) the manner in which the water is usually raised;
 - (6) the average area attached to and commanded by a well;
 - (7) the average area irrigated in any one year.
35. To what extent does the irrigation increase the value of the produce of land—
- (1) by rendering it possible to cultivate two harvests instead of one?
 - (2) by leading to the substitution of more for less valuable crops or varieties?
 - (3) by increasing the yield—
 - (a) in a year of ample rainfall?
 - (b) in a year of scanty rainfall?
 - (c) in a year of drought?

36. Can you give an approximate estimate of the increase in the total annual value of the produce per acre due to the irrigation—

- (1) on the average of a normal term of years?
- (2) in a year of drought?

37. What is approximately the average annual rate per acre paid on account of the irrigation—

- (1) by the cultivator to the owner in the shape of enhancement of rent?
- (2) by the owner to Government in the shape of enhancement of revenue?

Are these rates paid on the total area attached to and commanded by the well or on the area actually irrigated during the year, or how?

38. Are serious difficulties often encountered—

- (1) in the selection of a spot in which a supply of water will be obtained?
- (2) in the actual construction of the well?

Has assistance ever been offered by Government or by local bodies in the shape of expert advice, trial borings, the use of boring tools, or otherwise? If so, how far has this assistance been made use of and found successful? If not, do you think it would be useful and how could it best be given?

39. Are you in favour of the construction by Government of wells in land which is private property? If so, how would you work the scheme? If not, what objections do you perceive?

40. Are temporary wells commonly used in the _____ district? How far are they a protection against drought? How would you propose to encourage their construction in a year of scanty rainfall?

(37) *Memorandum of points to be considered by the Irrigation Commission in the Punjab.*

1. For all districts subject to drought the proportion of the culturable area irrigated by Government canals, district canals, private canals, wells and other sources, respectively with reference to the population. Figures have been given by Chief Engineer, Irrigation, taken from the Land Revenue Administration Reports, but some explanations will probably be required from Revenue Officers.

2. Areas of present irrigated in ordinary and famine years by existing canals. Development of irrigation on them during last ten years and further developments anticipated. Duty and improvement of duty.

New projects in contemplation. Their position, scope and probable irrigating capacity.

Average capital cost of canals per cusec of maximum supply or per acre annually irrigable. Also average gross revenue and working expenses per acre irrigated.

Are many extensions or improvements of minor works which would be certain to prove remunerative or to increase the efficiency of these works held in abeyance owing to restriction of funds available from the ordinary grant?

Ratio of average *rabi* supply to maximum discharging capacity of canals. Possibility and consequences of providing a supplementary *rabi* supply on certain canals.

Drainage of irrigated tract. Scope for drainage works and other canal improvements, such as diversions or on-*off*, which may be reserved for relief labour in seasons of famine.

Notes on most of these points have been prepared by the Chief Engineer upon which he and his officers will be orally examined. Civil officers will probably also have opinions to offer on some of these points.

3. Number and capacities of the Provincial canals. Provincial. Expenditure on new works and on maintenance during last ten years.

New Provincial works, if any, sanctioned or proposed. Extent to which Provincial revenues have been applied to the construction of new irrigation works and the limitations to such application. Does the Province get the whole of the increase of revenue due to the construction of such works? Have present arrangements under the Provincial settlement the effect of encouraging or discouraging the application of Provincial revenues to works of irrigation? Is it desirable that Provincial revenues should in future be devoted to the construction of such works, or should all new works be constructed from Imperial Funds? In what cases should new irrigation works be undertaken as a charge against Provincial Funds.

4. Districts in which irrigation works have been constructed or are controlled by the District Boards, or in which there is still a field for such works. Names of existing works, their irrigating capacity, capital cost and gross and net revenue. Should District Boards be encouraged to undertake such work, or may District Funds be reasonably appropriated to such purposes for the benefit of a few landowners? In districts in which new works of this class can be proposed, is it desirable that they should be undertaken by the District Boards, and if not, by what

agency should they be constructed or controlled? What credits are made to the Boards on account of these works? Are they empowered by law to levy water rates, or are such rates levied by agreement? Are they entitled to any contribution from Government, in consideration of the increase of land revenue that may be due to the works?

5. Districts in which private canals of any importance exist. Do the numbers of these other than wells canals show a tendency to increase or decrease, and have many or any new private canals been constructed within last ten years? Are such canals constructed by individual landlords for the benefit of their tenants, or by associations of landlords or cultivators, and is water supplied to outsiders, and if so, on what terms? Is it desirable or possible to encourage the multiplication of these works in particular districts, and if so, in what way could encouragement be most effectually given?

6. Districts in which the extension or security of cultivation must depend mainly on construction of new wells. Number of new wells constructed in such districts during last ten years. Inducements and assistance offered to landlords or cultivating tenants who propose to sink wells. Are these sufficient and is it likely that the construction of wells would be greatly stimulated by the offer of more liberal inducements or assistance on simpler or easier terms? Average depth of water below surface. Have wells been abandoned owing to failure of the water-supply or from other causes? Average cost of wells and average area irrigated by a well (1) in an ordinary year, and (2) in a famine year.

7. Districts in which flood protection or drainage works Flood protection and are required. Are these of sufficient urgency to be carried out who ever funds may be available, or may they be reserved for the employment of relief labour? Would such works lead to any increase or prevent any loss of land revenue, or are they recommended only on sanitary grounds, or as a means of employment for relief labour?

8. Classification of the works in which relief labour was employed in the districts affected, Works executed by relief labour during the famines of 1897 and 1900. and amount expended on each class, say Roads and Road-metal—Railway work, including collection of ballast—Irrigation works—Village tanks and other water storage works—Miscellaneous—

Works uncompleted at end of famine which it is considered desirable to complete as a charge against Provincial or Imperial revenues. Reasons for proposing their early completion and results anticipated. Results attained on completed irrigation or storage works, especially village tanks. Have they been found to hold water and to improve or conserve the resources of the village for watering cattle, etc.?

9. Districts for which programmes have and have not been prepared. Examination of programmes, especially for districts most liable to famine, with reference to the number of units provided for, the distribution of the work over the district, and their utility. Arrangements for maintaining, extending or completing the programmes.

